Poisoning Our Imperiled Wildlife

San Francisco Bay Area Endangered Species at Risk from Pesticides









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Executive Summary

The San Francisco Bay Area is valued for its extensive open space and the spectacular San Francisco Bay, which provide scenic views and recreational opportunities for nearly 10 million people. The unique Bay Area wildlands, which give us inspiration and connection to nature, harbor rich biological diversity. The varied ecosystems around the Bay provide habitat for numerous endangered species of animals and plants. However, the health of the Bay and these habitats are at risk due to extensive agricultural and urban pesticide use. Toxic pesticides that are sprayed on our food, our soil and our lawns find their way into local creeks and ultimately the Bay, posing a significant threat to water quality and jeopardizing endangered species. Toxic pesticide use not only poisons some of our most imperiled wildlife, it threatens human health – particularly the health of children.

This report examines the risk that toxic pesticides pose to endangered species in the nine Bay Area counties: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo and San Francisco. At least 30 of the 51 federally endangered or threatened animal species that survive in the Bay Area may be adversely affected by the more than eight million pounds of pesticides used in the Bay Area each year. This report also discusses the failure of the U.S. Environmental Protection Agency (EPA), the governmental agency charged with guaranteeing the safety of pesticides for public use, to ensure that its pesticide authorizations do not harm endangered species.

More than two billion pounds of pesticides are sold each year in the U.S. for agricultural, commercial and home uses. The EPA has registered more than 18,000 pesticides, over 900 of them registered for use in California. Based on reported uses alone, more than 43 million pounds of pesticide active ingredients were applied in the Bay Area from 1999 to 2003. Actual pesticide use may have been up to several times this amount since pesticide applications not made by professional applicators—particularly home and garden use and most industrial, commercial and institutional uses—do not have to be reported to the state. For example, the San Francisco Estuary Project's *Pesticides in Urban Surface Waters*: *Urban Pesticides Use Trends Annual Report 2005* estimated that about 73 percent of California pesticide use in 2003 did not require reporting.

It would be easy to assume that pesticide products for sale are safe because they are registered by the EPA. Such faith would be misplaced, since the EPA has blindly registered many toxic pesticides for public use at the behest of the agrochemical industry rather than independently assessing the risks of pesticides to the health of humans, animals and ecosystems. As documented in the 2004 Center for Biological Diversity report, *Silent Spring Revisited*,[1] the EPA's regulatory oversight of the pesticide industry is abysmal. While the EPA is entrusted to protect public health and the environment, the agency tends to dismiss credible studies and scientific findings on the adverse impacts of pesticides; it also ignores mounting evidence demonstrating that even low doses of pesticides in wildlife and humans can have drastic consequences.

A 1999 Pesticide Action Network North America (PANNA) report, *Disrupting the Balance: Ecological Impacts of Pesticides in California*, documented the impact of pesticides on wildlife statewide.[2] The report found that multiple pesticides are often found in California waters and sediments at concentrations exceeding levels lethal to zooplankton, a primary food source for fish. The PANNA report also discussed the effects of routine toxic pulses of diazinon and chlorpyrifos in California streams during critical stages in fish development. Pesticide contamination of the Bay Area's waterways is an ongoing problem, and as detailed in this report, aquatic species are particularly vulnerable to pesticides. Much of the San Francisco Bay and Delta and many Bay Area streams are listed as "impaired" or not meeting water quality standards due to high concentrations of pesticides such as chlordane, chlorpyrifos, DDT, diazinon and dieldrin. Although some organophosphate chemicals such as chlorpyrifos and diazinon are being gradually phased out from household use, the agrochemical industry is now turning to pyrethroid pesticides that are known to accumulate in aquatic sediment and become highly toxic.

Pesticides also affect our songbirds, waterfowl and raptors. For example, the pesticides carbofuran and diazinon are responsible for the majority of bird kills in California; as many as 17 birds are killed for every five acres treated with carbofuran. Pesticides can disrupt the balance between pest and predator insects and kill beneficial insects needed for pollination and other ecosystem services. Finally, there is mounting evidence that pesticides are having population level effects on some of our most imperiled amphibians and on formerly abundant fish species in the Delta, which should serve as a warning about the health of the aquatic ecosystems we depend upon for clean water and abundant wildlife.

In its rush to get pesticides on the market, the EPA has consistently disregarded requests by the U.S. Fish and Wildlife Service to alter pesticide registrations because of adverse impacts to endangered wildlife. The Service enforces the Endangered Species Act and has the responsibility to cooperate with other agencies in assessing the impact of government actions on endangered species. Yet for over a decade, the EPA has refused to complete mandated formal consultations with the Service on pesticide impacts to endangered species and is now attempting to delay compliance for another 10 to 15 years. As discussed in

this report, there are also troubling scientific deficiencies in the EPA's assessments of pesticide risks and its pesticide regulation process.

In 1972, spurred by the publication of Rachel Carson's *Silent Spring*, Congress explicitly put environmental standards into the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). One of the weaknesses of FIFRA in protecting endangered wildlife from toxic pesticides is its cost-benefit standard. It allows unacceptable risks to human health and the environment to continue based on economic benefits – in contrast to other federal laws that tolerate less harm, such as the Endangered Species Act and Clean Water Act. FIFRA also allowed pesticides to stay on the market until the EPA gets around to re-registering them, which the EPA still has not done for many pesticides although it has a statutory deadline of August 2007 to do so. Furthermore, since the EPA has consistently failed to ensure that its pesticide authorizations comply with the Endangered Species Act while re-registering old pesticides, these toxic pesticides will still be authorized for use in sensitive habitats and adjacent areas when the agency completes its re-registrations in 2007.

The EPA's rampant violations of the Endangered Species Act have led courts to order the agency to start bringing some pesticide registrations into compliance with the Act. In response, the EPA has tried to legitimize their delay by writing it into their so-called Endangered Species Protection Program. The EPA proposes to take an additional 15 years to address its ongoing Endangered Species Act violations and is asking the public to trust the agency to review pesticide registrations through a new process that is not even in place yet. The chemical industry has also pressed for a legislative exemption to allow the EPA to continue to delay consultations and protections for endangered species. A Congressional rider on an appropriations bill that would have further restricted the review of dangerous pesticides with regards to their effects on endangered species was defeated in 2005. To make matters worse, Congressman Richard Pombo's anti-endangered species bill, which passed the House of Representatives in 2005, would suspend for five years the requirement that new agricultural and commercial pesticides not directly kill, harm or jeopardize the survival or recovery of threatened and endangered species.

The Bush administration is attempting to further subvert the public interest through new regulations that eliminate important protections in the EPA registration process, circumventing the Fish and Wildlife Service's scientific oversight of pesticide impacts on endangered species. Regulations adopted in July 2005 – after conservation groups were successful in a series of lawsuits based on the EPA's admitted failure to determine the impact of pesticides on wildlife – leave the EPA with sole responsibility for assessing pesticide effects on endangered species and allow the agrochemical industry to control all research on the impacts of its products. If allowed to stand, these changes will have detrimental environmental effects on the imperiled wildlife of the San Francisco Bay Area as well as on human health. These unacceptable regulations, which explicitly adopt the EPA's long-standing refusal to comply with federal law, are being challenged by conservation groups.

The health of our endangered species is a barometer for the human residents of the Bay Area, since pesticides detected in wildlife habitats also find their way into our drinking water, food supply, homes and gardens, and schools and workplaces. Ultimately, pesticides that harm steelhead trout or red-legged frogs also pose a health risk to farm workers, families and communities. If our society can put a man on the moon, we should be able to prevent our children, who are particularly susceptible to pesticides, and imperiled wildlife from exposure to our most toxic poisons.

Changing the abysmal pesticide oversight situation at the EPA is essential to efforts to clean up the poor state of water quality in San Francisco Bay and its tributaries, and to protect the region's endangered and threatened species. This report closes with policy recommendations for the EPA and suggestions for homeowners to reduce our pesticide risk to protect human health and to help maintain the ecological health of the San Francisco Bay Area.

Background on Pesticide Impacts

Contaminated Waterways

Acutely toxic pulses of pesticides move down the Sacramento and San Joaquin Rivers and local San Francisco Bay streams and through the estuaries and Bay Delta with "remarkable persistence and relatively little dilution," according to the U.S. Fish and Wildlife Service (USFWS).[3] Researchers have reported episodic toxicity in the Delta involving peaks of organophosphate pesticides, carbofuran, chlorpyrifos, trifluralin and atrazine.[4] Such pulsed introduction of pollutants may increase the time of exposure to pesticides or expose fish and other aquatic organisms during biologically sensitive times.

There is growing evidence that numerous fish species in the Delta are suffering direct mortality or additional stress from the presence of toxic substances such as pesticides. There is also evidence that the plankton upon which Delta fish feed may be depleted by highly concentrated pulses of pesticides. The Delta's open water forage fish populations are collapsing in a crisis that potentially threatens the entire estuarine food web. In fall 2004, Delta smelt and juvenile striped bass in the Delta were at their lowest ever recorded levels, and copepods, the main food source for small fish in the Delta, have also fallen to extremely low levels. Toxic chemicals including pesticides and herbicides are suspected to play a role in these alarming declines.

Agricultural and urban runoff transport pesticides away from their application areas, with pesticides either dissolved in water or bound to suspended sediments in the water. The U.S. Geological Survey (USGS) recently released several reports on nationwide water quality surveys, documenting the astounding prevalence of pesticides in our nation's waterways, particularly in streams and ground water located in basins with significant agricultural or urban development.[5] This polluted runoff can pose acute and chronic problems to wildlife and plants. Not surprisingly, the USGS noted a direct correlation between the amounts and types of pesticides used and their frequency in nearby surface waters. Mixtures of multiple pesticides were commonly found in stream samples and pesticides were at concentrations established by the Environmental Protection Agency (EPA) as levels of concern. Yet the EPA continues to assess the risk of each pesticide individually, failing to consider cumulative and synergistic effects. Moreover, the USGS studies only represent a brief snapshot of pesticides in our environment, since they did not assess aquatic pesticide concentrations through daily monitoring over the entire seasons that pesticides are used. With limited sampling size, the studies most likely do not reflect the highest concentrations and fail to measure the duration pesticides persist in our waters.

Pesticide contamination of waterways is an ongoing problem in the San Francisco Bay Area. Most of the San Francisco Bay and Delta is listed as "impaired" or not meeting EPA water quality standards due to high concentrations of the pesticides chlordane, DDT, diazinon and dieldrin. Of particular concern are the Sacramento-San Joaquin Delta, Carquinez Strait, Suisun Bay, Richardson Bay, San Pablo Bay, San Francisco Bay, the Oakland Inner Harbor and San Leandro Bay.[6] In 2005, the California Regional Water Quality Control Board proposed adding several water bodies to the impaired list due to pesticides: Lake Chabot for chlordane, DDT and dieldrin; San Pablo Reservoir for chlordane, dieldrin, heptachlor and toxaphene; and San Leandro Bay, Stege Marsh in Richmond and Stevens Creek for chlordane and dieldrin.[7]

Thirty-seven creeks draining into San Francisco Bay are also listed as impaired due to high concentrations of the pesticide diazinon, including: Arroyo Corte Madera Del Presidio, Corte Madera Creek, Coyote Creek, Gallinas Creek, Miller Creek, Novato Creek, San Antonio Creek and San Rafael Creek in Marin County; the Petaluma River in Sonoma County; Laurel Creek, Ledgewood Creek and Suisun Slough in Solano County; Mount Diablo Creek, Pine Creek, Pinole Creek, Rodeo Creek, San Pablo Creek, Walnut Creek and Wildcat Creek in Contra Costa County; Alameda Creek, Arroyo De La Laguna, Arroyo Del Valle, Arroyo Las Positas, Arroyo Mocho, lower San Leandro Creek and San Lorenzo Creek in Alameda County; Calabazas Creek, Coyote Creek, the Guadalupe River, Los Gatos Creek, Matadero Creek, Permanente Creek, San Felipe Creek, Saratoga Creek and Stevens Creek in Santa Clara County; and San Francisquito Creek and San Mateo Creek in San Mateo County.[8]

Contaminated Sediments

The health of the Bay's sediment is important because it provides habitat for benthic organisms at the bottom of the food chain, such as clams and insects, which are a food source for fish. The presence of pesticides in Bay sediments or on stream bottoms also indicates that pesticides are or were present in the Bay or in the water of a stream.[9] Stream sediments can act as a reservoir for contaminants, with pesticides entering and leaving stream bottom sediments through numerous pathways. Stream sediments can be contaminated by settling of contaminated suspended sediments, re-suspension and export of sediments in the water column, adsorption onto and release from mineral or organic sediments, interactions with stream-bottom organisms, ingestion or absorption by organisms, and elimination of

wastes and release from decaying contaminated organisms.[10] Pesticides can persist and accumulate in sediment and in aquatic organisms through these processes even at concentrations too low to be detected using conventional methods.

Pesticides of concern enter the water and active sediment of San Francisco Bay in runoff from the Central Valley and local watersheds. The USGS is studying sediments transported into the San Francisco Bay Estuary from the Sacramento and San Joaquin Rivers, which carry waters from the Central Valley where more than 500 different pesticides are used.[11] Pesticides in sediments may account for much of the pesticides transported to estuaries, where they have different environmental effects than dissolved pesticides, affecting aquatic life differently and posing a particular risk to filter-feeding pelagic and benthic organisms. The majority of suspended sediments move into estuaries in annual pulse flows with the first flush of runoff from the first major winter storm; contaminated sediments remain in estuaries longer than contaminated water does, increasing exposure risk for some aquatic organisms."[12]

Pesticide Drift

Pesticides can also travel inadvertently to sensitive habitats through pesticide drift: the, airborne movement of pesticides away from a target site, resulting from aerial application or from wind movement over soils containing pesticides. Pesticides can drift as droplets, dusts, volatilized vapor-phase pesticides or pesticide-contaminated soil particles. Aerial pesticide applications typically result in "considerable" off-site drift, according to the National Research Council.[13] The amount of pesticide drift can vary from 5 percent under optimal low-wind conditions to as high as 60 percent.[14] The Congressional Office of Technology Assessment estimates that about 40 percent of an aerial insecticide application leaves the target area and that less than 1 percent actually reaches the intended pest.[15] The typical range for drift is 100 to 1,600 meters; however, longer range drift up to 50 miles has been documented.[16]

Impacts to wildlife from pesticide drift have been documented, particularly to amphibians, for which pesticides appear to be compromising their immune systems. Studies implicate pesticide drift from the Central Valley in disproportional declines of several native frog species in the Sierra Nevada, even affecting frogs collected from high in the Sierra Nevada far from areas of direct pesticide use.[17] Studies have found a close correlation between declining populations of amphibians and exposure to agricultural pesticides, raising significant concerns about pesticide impacts on non-target organisms living far away from the point of application.[18]

In 2003, Californians for Pesticide Reform (CPR) released *Secondhand Pesticides: Airborne Pesticide Drift in California*,[19] documenting adverse impacts of pesticide drift on wildlife and humans. The CPR analysis found pesticides far from their application sites at concentrations significantly exceeding acute and chronic exposure levels deemed "safe" by the EPA. The thousands of reported complaints the EPA receives each year from around the country on off-target spray drift confirm the CPR study findings.

Although the EPA notes that spray drift continues to be of concern and has a policy to prevent pesticide drift from target sites, the agency acknowledges that some degree of drift occurs from nearly all applications. [20] The EPA relies on applicators voluntarily following pesticide labels to prevent drift, yet acknowledges that current labels are inadequate in preventing spray drift.[21] For example, in the recently released re-registration decision for the highly toxic pesticide atrazine, the EPA simply stated the following for spray drift management: "The Agency is currently working with stakeholders to develop appropriate generic labels to address spray drift risk. Once this process is completed, atrazine labels will need to be revised to include this additional language."[22] Although the EPA published draft guidance for label statements in 2001, it has yet to finalize label guidance for spray and dust drift, and the agency continues to rely on voluntary standards to control spray drift.[23]

The CPR study concluded that current EPA pesticide label language is inadequate to control spray drift. The EPA's failure to control spray drift places wildlife at risk and jeopardizes endangered species, in violation of the Endangered Species Act. Until the EPA aggressively addresses spray drift, it will also continue to abrogate its duties under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to protect humans and the environment from unreasonable adverse effects.

Effects of Pesticides on Wildlife

Birds

Although the pesticide DDT has been banned in the U.S. for over 25 years, other pesticides are still killing birds and causing avian reproductive problems throughout the country. For rare, endangered or threatened birds, even a few pesticide poisoning incidents can be significant, and interference with successful reproduction can jeopardize the entire species. Nationwide, annual avian mortality is estimated at 10 percent of the 672 million birds exposed to agricultural pesticides alone, although reported kills represent only a fraction of actual bird mortality. In California, the insecticides diazinon and carbofuran have caused most documented bird kills. Organochlorine pesticides, such as DDT, also continue to interfere with avian reproduction long after their use has been discontinued. Synthetic pyrethroids, similar to organochlorines, are also suspected to have reproductive effects on birds. Sub-lethal exposure to pesticides can chronically affect avian behavior, reproduction

and nervous system function. Birds exposed to pesticides can become more susceptible to predation, experience weight loss and have decreased resistance to disease. Pesticide exposure can also reduce interest in mating and defending territory and can cause birds to abandon their nestlings.

Amphibians

Due to their recognized sensitivity to contaminants, amphibians are a barometer of environmental health. Adverse impacts to amphibians are often the first sign that our ecosystems are under stress. Since amphibians respire through their skin and spend much of their life cycle in water, moving through the interface of water and air, they are at high risk from chemical pollutants. Pesticides are often insoluble in water and tend to concentrate on the surface. This heightens the risk to amphibians, which readily absorb chemicals through their permeable skins. Many studies have demonstrated that pesticide residues in water, sediment and vegetation can harm amphibians in aquatic environments by delaying or altering larval development or by reducing breeding or feeding activity.[24] Many pesticides currently in use can potentially disrupt amphibian endocrine systems, adversely affecting adult breeding and embryonic larval development.[25] For example, in a recent University of California study, the herbicide atrazine was found to disrupt sexual development of frogs at concentrations 30 times lower than levels allowed by the EPA.[26] Also of great concern is the possibility that pesticide pollutants act as environmental stressors, rendering amphibians more susceptible to aquatic pathogens and diseases.

Fishes

Fish in the Sacramento-San Joaquin Delta, San Francisco Bay and its tributaries inhabit an ecosystem already stressed by dams and water diversions, urban development and invasion of exotic species. The large concentrations of toxic pesticides that enter the Bay also affect many aquatic species. The widely used insecticides diazinon and chlorpyrifos are of particular concern in the Bay Area. Toxic pulses of pesticides occur regularly as storm water and irrigation runoff carry pesticides from urban and agricultural areas into surface waters. Multiple pesticides are found in Bay waters and sediments, often at concentrations above lethal levels for organisms eaten by fish. Pesticides can kill aquatic animals and plants, impair reproduction, and reduce food sources for fish. Numerous fish species in the San Francisco Bay Delta have recently experienced dramatic population declines, and toxic contaminants are thought to be one of the major stressors affecting fish in the Bay Delta ecosystem.

Insects

Broad-spectrum pesticides used to destroy pest insects can disrupt the natural balance between pest and predator insects and indiscriminately kill beneficial insects as well. Many beneficial insects play essential roles in pollination, soil aeration, nutrient cycling and pest control. Pest insect populations can often recover more rapidly than beneficial insects because of their larger numbers and ability to develop resistance to pesticides. With rapid reproduction and no predators to check their numbers, this can cause a resurgence of the target pest and secondary pests. Escalating pesticide applications can result in pests with even greater resistance to pesticides, and the "pesticide treadmill" goes around and around. Although nationwide insecticide use increased 10-fold from 1945 to 1989, crop losses from insects nearly doubled and now more than 500 pest species are resistant to pesticides nationwide. Meanwhile, according to the U.S. Department of Agriculture, we are facing an "impending pollinator crisis," in which both wild and managed pollinators are disappearing at alarming rates, partly due to pesticides.[27]

Plants

Herbicide use is obviously a threat to listed plant species, since herbicides are chemicals specifically formulated to kill plants. Herbicides are widely applied to gardens, lawns and crops to control unwanted plants and weeds, but can affect non-target plants through aerial drift or runoff. Herbicides applied indiscriminately to roads and right-of-ways have been documented to kill rare or listed plant species in the Bay Area.

Endocrine Disruption, Sexual Deformities and other Reproductive Anomalies

Endocrine disruptors are synthetic chemicals that mimic natural hormones, disrupting natural processes by sending false messages, blocking real messages, preventing synthesis of the body's own hormones, and accelerating the breakdown and excretion of hormones. Endocrine disruption affects how animals develop and function and can cause severe damage during critical developmental stages.[28] Reproductive disorders, immune system dysfunction, thyroid disorders, types of cancer, birth defects and neurological effects have all been linked to endocrine disruption. Offspring of those affected by endocrine disruptors may also suffer from lifelong health and reproductive abnormalities, including reduced fertility, altered sexual behavior, lowered immunity and cancer.[29]

Over 60 percent of all agricultural herbicides applied in the U.S. (measured by volume) have the potential to disrupt endocrine and/or reproductive systems of humans and wildlife.[30] Several organophosphate and carbamate pesticides are recognized as endocrine disruptors.[31] Studies have shown endocrine disrupting effects from the pesticides atrazine, chlordane, DDT, dieldrin, endosulfan, malathion, methoprene and methoxychlor in amphibians, salmon, mice, turtles and aquatic arthropods.[32] Wildlife studies of gulls, terns, fishes, whales, porpoises, alligators and turtles also link environmental contaminants such as pesticides with disturbances in sex hormone production and/or action.

Studies suggest that pesticides can affect organisms at extremely low levels, even at concentrations too low to be detected; they also suggest that amphibians are likely to be far more sensitive to pesticides in the natural world than traditional laboratory tests used to establish regulatory standards indicate.[33] A compelling example is the University of California study showing that exposure of low levels of atrazine prevented the masculine characteristics of male frogs from fully forming and in some cases caused hermaphroditism.[34] This study exposed frogs to low levels of atrazine, which prevented the masculine characteristics of male frogs from fully forming and in some cases caused hermaphroditism. The extent of these deformities would likely be magnified in the natural environment because the highest atrazine levels coincide with the amphibian breeding season. Another study has demonstrated that exposure to multiple pesticides can cause endocrine, immune and behavioral changes even though no effects were noted from exposure to each chemical in isolation.[35]

Bay Area Pesticide Use

The California Department of Pesticide Regulation (CDPR) tracks registered pesticide use by total pounds of active ingredient applied. A recent analysis by the Pesticide Action Network comparing four years of reported use and reported sales of pesticides found that non-reporting may be significant, with reporting rates from 9 percent to 138 percent.[36] Actual use of pesticides in California can typically be up to three times the reported use,[37] since home and garden pesticide use and most industrial, commercial and institutional pesticide applications not made by professional applicators do not have to be reported to the state and are not reflected in these totals. Pesticide uses that require reporting are generally agricultural uses or urban application by licensed pest control operators.

In the five years from 1999 to 2003 (the most recent years for which data is available), use of over 43 million pounds of pesticide active ingredients was reported in the nine Bay Area counties.[38] Over 8.6 million pounds of pesticide active ingredients were reported applied over 2.37 million acres in the Bay Area in 2003 alone. In addition, a portion of the estimated 150 million pounds of pesticides applied to crops in the Central Valley each year is transported to the San Francisco Bay and Delta.

Reported Bay Area Pesticide Use from 1999 to 2003 (in pounds of active ingredients)

Marin County	349,632
Sonoma County	15,320,916
Napa County	10,388,521
Solano County	7,337,722
Contra Costa County	2,970,945
Alameda County	1,632,484
Santa Clara County	4,123,478
San Mateo County	1,270,711
San Francisco County	97,302
Total	43,491,711

Pesticide Use by County

Marin County

Reported pesticide use in Marin County from 1999 to 2003 averaged about 70,000 pounds of active ingredients per year. In 2003, over 59,000 pounds of pesticides were reported applied over 9,508 acres. The top five reported pesticide uses in Marin County in 2003 were sulfuryl fluoride, sulfur, copper sulfate, disodium octaborate tetrahydrate and formaldehyde.

Sonoma County

Reported pesticide use in Sonoma County from 1999 to 2003 averaged over three million pounds of active ingredients per year. In 2003, over 2,890,000 pounds of pesticides were reported applied over 813,011 acres. The top five reported pesticide uses in Sonoma County in 2003 were sulfur, 1,3-dichloropropene, isopropylamine salt glyphosate, unclassified petroleum oil and refined petroleum distillates.

Napa County

Reported pesticide use in Napa County from 1999 to 2003 averaged over two million pounds of active ingredients per year. In 2003, over 1,930,000 pounds of pesticides were reported applied over 577,747 acres. The top five reported pesticide uses in Napa County in 2003 were sulfur, isopropylamine salt glyphosate, potassium bicarbonate, refined petroleum distillates and copper hydroxide.

Solano County

Reported pesticide use in Solano County from 1999 to 2003 averaged just under one and a half million pounds of active ingredients per year. In 2003, just under 1,090,000 pounds of pesticides were reported applied over 566,652 acres. The top five reported pesticide uses in Solano County in 2003 were sulfur, metam-sodium, unclassified petroleum oil, isopropylamine salt glyphosate and 2,4-D.

Contra Costa County

Reported pesticide use in Contra Costa County from 1999 to 2003 averaged over 590,000 pounds of active ingredients per year. In 2003, over 990,000 pounds of pesticides were reported applied over 183,061 acres. The top five reported pesticide uses in Contra Costa County in 2003 were petroleum distillates, sulfur, isopropylamine salt glyphosate, diuron and kaolin.

Alameda County

Reported pesticide use in Alameda County from 1999 to 2003 averaged over 325,000 pounds of active ingredients per year. In 2003, over 440,000 pounds of pesticides were reported applied over 48,559 acres. The top five reported pesticide uses in Alameda County in 2003 were isopropylamine salt glyphosate, sulfuryl fluoride, diuron, 2,4-D and calcium hypochlorite.

Santa Clara County

Reported pesticide use in Santa Clara County from 1999 to 2003 averaged almost 825,000 pounds of active ingredients per year. In 2003, over 978,000 pounds of pesticides were reported applied over 150,730 acres. The top five reported pesticide uses in Santa Clara County in 2003 were sulfuryl fluoride, metam-sodium, sulfur, isopropylamine salt glyphosate and chloropicrin.

San Mateo County

Reported pesticide use in San Mateo County from 1999 to 2003 averaged over 250,000 pounds of active ingredients per year. In 2003, over 273,000 pounds of pesticides were reported applied over 29,000 acres. The top five reported pesticide uses in San Mateo County in 2003 were sulfuryl fluoride, petroleum distillates, potassium n-methyldithio carbamate, disodium octaborate tetrahydrate and liquefied nitrogen

San Francisco County

Reported pesticide use in San Francisco County from 1999 to 2003 averaged over 19,000 pounds of active ingredients per year. In 2003, over 12,000 pounds of pesticides were reported applied. The top five reported pesticides used in San Francisco County in 2003 were boric acid, isopropylamine salt glyphosate, butoxyethyl ester triclopyr, disodium octaborate tetrahydrate and acephate.

Pesticides of Concern in the Bay Area

Case Study: Atrazine

Atrazine, the most commonly used herbicide in the United States, is so dangerous to humans and wildlife that it was recently banned by the European Union. Numerous studies have provided overwhelming evidence linking atrazine to significant human and wildlife health concerns, including endocrine disruption. Atrazine is also linked to declines of endangered amphibians in California and many other endangered species throughout the country. Recent studies by Dr. Tyrone Hayes at the University of California have strengthened the case for banning atrazine, the most common contaminant of ground, surface, and drinking water. Dr. Hayes demonstrated that atrazine is an endocrine disruptor that directly affects the sexual development of amphibians, chemically castrating and feminizing male frogs at concentrations 30 times lower than levels allowed by the EPA.[39] Atrazine shrank the larynges of male frogs at doses as low as one part per billion, which is significant because the frogs use vocalization to mate.

Furthermore, atrazine exceeds EPA toxicity levels of concern for direct chronic effects on mammals, birds, fish, aquatic invertebrates and direct acute effects on non-target terrestrial and aquatic plants. Atrazine may persist in the environment at concentrations in excess of levels of concern for months. It is also highly toxic to aquatic plants and has sub-lethal and indirect effects on aquatic vertebrates and invertebrates. Due to its high mobility and solubility, atrazine is likely to find its way into groundwater[40] and thus poses a risk to the health and integrity of aquatic communities. Specifically, reported sub-lethal effects of atrazine include endocrine disruption in fish and frogs and olfactory effects in salmon. Atrazine is also known to increase the toxicity of organophosphate insecticides, such as chlorpyrifos. Use of atrazine in the Bay Area is of particular concern for amphibians such as the California red-legged frog and California tiger salamander, and for fish such as Delta smelt, salmon and steelhead trout. Reported Bay Area use of atrazine was only 3,700 pounds from 1999 to 2003, primarily in Solano and Contra Costa counties. However, the actual unreported Bay Area use of atrazine, including widespread home, garden and unreported commercial use, was likely considerably higher.

Case Study: Carbaryl

Carbaryl is a carbamate insecticide that is very toxic to aquatic invertebrates and to fish, particularly salmonids. This chemical may affect swimming capability and increase vulnerability of fish to predation. It is also toxic to honeybees, earthworms, crustaceans, stone flies and mayflies. For mammals, carbaryl is suspected to be a carcinogen, mutagen and viral enhancer and is suspected to decrease fertility. Carbaryl is an endocrine disruptor that may affect breeding success and reproduction for birds and fish due to long-term toxicity. It binds to soil and can find its way into water in run-off. Use of carbaryl in the Bay Area is of particular concern for salmon, steelhead trout and the California red-legged frog. Reported use of carbaryl in the Bay Area from 1999 to 2003 was over 87,000 pounds. However, the San Francisco Estuary Project estimated that actual Bay Area use of carbaryl in 2003 alone was 30,000 pounds, when use of just over 10,000 pounds was reported.[41] Thus, actual Bay Area use of carbaryl from 1999 to 2003 may have approached over 250,000 pounds.

Case Study: Chlorpyrifos

Chlorpyrifos is an organophosphate insecticide with both agricultural and urban uses. It is the most widely used insecticide in the U.S. and consequently has been detected in groundwater and in surface water. Virtually all homeowner uses of chlorpyrifos were banned in the U.S. in December of 2001.

Chlorpyrifos has very high immediate toxicity for mollusks, fish, crustaceans, bees and aquatic insects; high to very high immediate toxicity for birds; and low to high immediate toxicity for amphibians. For mammals, chlorpyrifos can have cumulative long-term effects, is known to be a fetotoxin and delayed neurotoxin, and may cause sterility and impotence. Long-term exposure to chlorpyrifos can cause leg weakness and delayed neurotoxicity for birds, affect the growth of fish, and affect the reproduction and equilibrium of crustaceans. Chlorpyrifos is also toxic to some plants. Chlorpyrifos was found to cause 80 percent mortality in 17 of 23 beneficial insects tested by the International Organization for Biological Control.[42] Bio-concentration of chlorpyrifos in ponds and estuarine areas may pose acute and/or reproductive risks to aquatic birds and mammals feeding adjacent to treated areas.[43] Synergistic interactions have been observed between chlorpyrifos and other chemicals, enhancing its toxicity.[44]

Use of chlorpyrifos in the Bay Area is of particular concern for fish such as Delta smelt and Pacific salmon, and for the California red-legged frog, California tiger salamander and brown pelican. Reported use of chlorpyrifos in the Bay Area from 1999 to 2003 was over 264,000 pounds.[45] However, the San Francisco Estuary Project estimated that actual Bay Area use of chlorpyrifos in 2003 alone was 80,000 pounds, when use of just over 15,000 pounds was reported.[46] Thus, actual Bay Area use of chlorpyrifos from 1999 to 2003 may have approached over one million pounds.

Case Study: Diazinon

Diazinon is a widely used, highly toxic organophosphate insecticide. It has also been detected in groundwater and in surface water throughout the U.S., where it is highly toxic to aquatic invertebrates. Use of diazinon has been banned in the U.S. on golf courses and turf farms, since field kills of waterfowl have been reported following use on turf. The EPA recently banned residential use of diazinon because of the growing nationwide protest against its use from environmentalists and public health advocates.

Diazinon is very highly toxic to birds, mammals, fish, amphibians, beneficial insects and freshwater, estuarine and marine animals. Diazinon is also toxic to some plants. The use of diazinon as a seed dressing is of concern since it is highly toxic to birds. Bird kills associated with diazinon have been reported throughout the U.S, and in 1988 the EPA concluded that the use of diazinon in open areas poses a widespread and continuous hazard to birds. Diazinon has caused the second largest number of total known incidents of bird mortality of any pesticide in the U.S. Sub-lethal effects on aquatic invertebrate behavior and growth of early life stages of fish have been reported at low concentrations of diazinon.

Use of diazinon in the Bay Area is of particular concern for the California red-legged frog, many birds, and fish such as the Delta smelt, tidewater goby and Pacific salmon. Reported use of diazinon in the Bay Area from 1999 to 2003 was over 264,000 pounds.[47] However, the San Francisco Estuary Project estimated that actual Bay Area use of diazinon in 2003 alone was 50,000 pounds, when use of just over 15,000 pounds was reported, and the California Regional Water Quality Control Board reports that the Bay Area uses about 170,000 pounds of diazinon each year.[48] Thus, actual Bay Area use of diazinon from 1999 to 2003 may have approached one million pounds.

Other Pesticide Use

Acephate

Acephate is an organophosphate insecticide used on field, fruit and vegetable crops and golf courses. All uses of acephate form the breakdown product methamidophos, which exceeds EPA toxicity levels of concern for endangered species of mammals, amphibians, reptiles, insects and freshwater invertebrates. The immediate toxicity of acephate is medium to high for birds and high for bees. Acephate has been attributed elsewhere to die-offs of birds. Long-term toxicity effects of acephate may include altered behavior and breeding success for birds, suspected carcinogenic and mutagenic effects for mammals, as well as toxicity to fetuses and some evidence of hormonal effects for mammals. Use of acephate in the Bay Area is of particular concern for the California tiger salamander and California red-legged frog. Reported use of acephate in the Bay Area from 1999 to 2003 was over 40,000 pounds.

Aluminum Phosphide

Aluminum phosphide is a burrow fumigant used as a rodenticide. Use of aluminum phosphide in the Bay Area is of particular concern for the San Joaquin kit fox. Reported use of aluminum phosphide from 1999 to 2003 in the three East Bay counties where the kit fox occurs was over 22,000 pounds.

Azinphos-Methyl

Azinphos-methyl is a widely used agricultural insecticide commonly applied to fruit orchards. Azinphos-methyl is highly toxic to freshwater and marine fish and invertebrates. Potential exposure from spray drift and surface residues also places birds and mammals at risk. Azinphos-methyl exceeds EPA toxicity levels of concern up to 47-fold for birds and 99-fold for small mammals, strongly suggesting that adverse reproductive effects are likely from chronic exposure to sub-lethal doses. Azinphos methyl has caused massive fish kills throughout the U.S. There is evidence that azinphos-methyl kills aquatic organisms and there are also documented kills of birds, mammals and reptiles. Use of azinphos-methyl in the Bay Area is of particular concern for salmon, steelhead trout, California tiger salamander and California red-legged frog. Reported use of azinphos-methyl in the Bay Area from 1999 to 2003 was over 21,000 pounds.

Bensulide

Bensulide is an organophosphate herbicide used on grasses and weeds in food crops and golf courses. The most significant risk from bensulide is potential eggshell thinning for birds. Bensulide residues on wildlife food items can also pose a risk to mammals. Bensulide exceeds EPA toxicity levels of concern for freshwater fish and freshwater invertebrates, with high immediate toxicity for fish. Reported use of bensulide in the Bay Area from 1999 to 2003 was over 17,000 pounds.

Captan

Captan is a fungicide used on fruit and golf courses. Most food crop uses in the U.S. were cancelled in 1989. Captan exceeds EPA toxicity levels of concern for mammals, freshwater fish and invertebrates. Captan is known to have long-term carcinogen effects on mammals and is a suspected mutagen and immunotoxin as well. Reported use of captan in the Bay Area from 1999 to 2003 was over 8,000 pounds.

Carbofuran

Carbofuran is a carbamate pesticide widely used in agriculture. Many of its granular uses have been phased out due to the risk of mortality to wildlife. Carbofuran is extremely toxic to birds, affecting songbirds, waterfowl and raptors. This pesticide has been estimated to kill one to two million birds annually in the U.S.[49] and has caused the largest number of total known incidents of bird mortality of any pesticide in California.[50] Application of carbofuran to crops has resulted in as many as 17 bird kills for every five acres treated.[51] Use of carbofuran in the Bay Area is of concern for all birds, particularly the peregrine falcon, and for the giant garter snake, San Francisco garter snake and Delta smelt. Reported use of carbofuran in the Bay Area from 1999 to 2003 was over 9,000 pounds.

Chlorothalonil

Chlorothalonil is an organochlorine fungicide that has been detected in groundwater throughout the U.S. Chlorothalonil is highly toxic to fish and aquatic vertebrates and invertebrates. Chlorothalonil suspends to organic matter once in water and is slow to biodegrade in still waters, posing a risk to fish and their habitat. Chlorothalonil is persistent in soils and is also acutely toxic to crabs, frogs and water fleas. Long term chlorothalonil exposure in mammals can result in cancer and damage to skin, eyes and kidneys. The EPA has stated that registered uses of chlorothalonil "may adversely affect endangered species of birds (chronically), mammals (chronically), freshwater fish (acutely and chronically), freshwater invertebrates (acutely) and aquatic plants."[52]

Use of chlorothalonil in the Bay Area is of particular concern for the San Francisco garter snake, California clapper rail, salt marsh harvest mouse and listed butterfly species. Reported use of chlorothalonil in the Bay Area from 1999 to 2003 was over 109,000 pounds.

2,4-D

2,4-D is a selective herbicide widely used as a weed killer for lawns. Forms of the chemical are found in approximately 660 agricultural and home use products. 2,4-D readily moves into waterways, is capable of leaching into groundwater, and has been detected in groundwater and surface water throughout the U. S. 2,4-D is sometimes used as an aquatic herbicide and is used near waterways that may be drinking water sources. It is highly toxic to aquatic vertebrates and is clearly toxic to fish at early life-stages. 2,4-D is also toxic to crustaceans, birds and non-target insects. Although generally classified as non-toxic to beneficial insects, some adverse effects have been reported on the early life-stages and adults of some insects and, because of widespread use, insects of many kinds could be exposed. Long-term exposure to 2,4-D can affect egg production in birds and inhibit egg development in amphibians.

The EPA has noted concerns about 2,4-D causing abortions, skeletal abnormalities in mammals, developmental neurotoxicity and endocrine disruption. In November 2005 the California Office of Environmental Health Hazard Assessment announced its intention to list 2,4-D and related compounds as developmental toxicants under California's Safe Drinking Water and Toxic Enforcement Act of 1986. Centers for Disease Control studies indicate that one quarter of the U.S. population carries 2,4-D in their bodies, and children between the ages of six and 11 have significantly higher exposure rates. Use of 2,4-D in the Bay Area is of particular concern for Pacific salmon, steelhead trout and the salt marsh harvest mouse. Reported use of 2,4-D in the Bay Area from 1999 to 2003 was over 262,000 pounds.

1,3-Dichloropropene

1,3-Dichloropropene is a fungicide and insecticide. 1,3-D is acutely toxic to terrestrial and aquatic invertebrates as well as fish. It is often contaminated with the more highly toxic and persistent chemical 1,2-dichloropropane. Reported use of 1,3-D in the Bay Area from 1999 to 2003 was 800,000 pounds.

Dicofol

Dicofol is an insecticide used to kill mites on a variety of fruit, vegetable, ornamental and field crops. Dicofol is manufactured from and is structurally similar to DDT. It is highly toxic to aquatic life and can cause eggshell thinning in some bird species. Dicofol is highly to very highly toxic to a range of aquatic organisms, including fish, invertebrates and estuarine/marine organisms. Environmental concerns have prompted Sweden to ban dicofol. Use of dicofol in the Bay Area is of particular concern for the peregrine falcon and California red-legged frog. Reported use of dicofol in the Bay Area from 1999 to 2003 was over 15,000 pounds.

Disulfoton

Disulfoton is an insecticide primarily used on field crops, fruit and nut trees, ornamentals and Christmas trees. Endangered species levels of concern have been exceeded for birds, mammals, freshwater fish, freshwater invertebrates, marine/estuarine fish and marine/estuarine invertebrates. Endangered terrestrial, semi-aquatic and aquatic plants may also be affected by this pesticide. Use of disulfoton in the Bay Area is of particular concern for the California red-legged frog, Swainson's hawk, Valley elderberry longhorn beetle and Delta green ground beetle. Reported use of disulfoton in the Bay Area from 1999 to 2003 was over 6,900 pounds.

Diuron

Diuron is a highly persistent herbicide with a half-life of longer than six months. Its toxicity to endangered plants is of great concern. Use of diuron in the Bay Area is of particular concern for listed plant species, Pacific salmon and California freshwater shrimp. Reported use of diuron in the Bay Area from 1999 to 2003 was over 424,000 pounds.

Endosulfan

Endosulfan is a highly toxic insecticide used on crops. Endosulfan produces neurotoxic effects and incident data has confirmed toxicity to birds and fish. Endosulfan poisoning incidents account for the greatest percentage of non-target mortality reported in the EPA's Ecological Incident Information System outside of incidents associated with organophosphates and carbofuran. The EPA also acknowledges that endosulfan is an endocrine disruptor. The EPA's ecological assessment indicates endosulfan is very highly toxic to both terrestrial and aquatic organisms.[53] Use of endosulfan in the Bay Area is of particular concern for the California red-legged frog and California tiger salamander. Reported use of endosulfan in the Bay Area from 1999 to 2003 was over 9,800 pounds.

Esfenvalerate

Esfenvalerate is a pyrethroid insecticide used on vegetable crops, tree fruit, and nut crops. Esfenvalerate is highly toxic to bees and fish. Use of esfenvalerate in the Bay Area is of particular concern for the California red-legged frog. Reported use of esfenvalerate in the Bay Area from 1999 to 2003 was over 3,800 pounds.[54] However, the San Francisco Estuary Project estimated that actual Bay Area use of esfenvalerate in 2003 alone was 4,000 pounds, when only 778 pounds were reported.[55] Thus, actual use of esfenvalerate in the Bay Area from 1999 to 2003 may have approached 20,000 pounds.

Ethafluralin

Ethafluralin is a selective herbicide used in crop areas. The EPA's ecological assessment of ethafluralin found that endangered species levels of concern were exceeded for freshwater organisms and estuarine/marine invertebrates. The EPA stated that it has concerns about the exposure of threatened and endangered plant and animal species to ethafluralin.[56] Reported use of ethafluralin in the Bay Area from 1999 to 2003 was over 14,000 pounds.

Ethoprop

Ethoprop is a fairly persistent organophosphate insecticide used on agricultural crops and golf courses. Ethoprop is a known cholinesterase inhibitor that is very highly toxic to avian species and causes reproductive effects. Ethoprop is applied on many crops during spring, a critical period for bird and mammal species, resulting in high acute and chronic reproductive risk from ingestion of granules or contaminated food. Endangered species levels of concern are exceeded for single broadcast applications of granular and non-granular ethoprop for birds, for all feed items other than seeds and granular products for mammals, and for freshwater fish and invertebrates and estuarine fish and invertebrates for all uses except golf course silt use. The likelihood of adverse effects on aquatic organisms is increased by the fact that ethoprop can contaminate surface water through runoff for up to several months after application. Reported use of ethoprop in the Bay Area from 1999 to 2003 was 900 pounds, almost all applied in Santa Clara County.

Fenamiphos

Fenamiphos is an organophosphate insecticide used on food crops, ornamentals and golf courses. The immediate toxicity of fenamiphos is very high for birds, medium to very high for fish and high for bees. At current registered rates and uses, endangered species levels of concern are exceeded for all terrestrial and aquatic organisms. The EPA stated that it has concerns about the risks posed to endangered aquatic and terrestrial animal species exposed to fenamiphos under current use practices and application methods.[57] Use of fenamiphos in the Bay Area is of particular concern for the California red-legged frog and California tiger salamander. Reported use of fenamiphos in the Bay Area from 1999 to 2003 was over 13,900 pounds.

Malathion

Malathion is an organophosphate insecticide used on agricultural food and feed crops, Christmas trees and landscaping. Drift from ultra-low volume aerial applications and the fate of its breakdown product malaoxon in the environment are of concern. Malathion has an endocrine disrupting effect and a wide range of long-term effects on mammals including damage to eyesight, abnormal brain waves, immunosuppression and delayed neurotoxicity. Malathion has a very high immediate toxicity for bees, amphibians and aquatic insects. Endangered species levels of concern are exceeded for acute hazard to endangered fish, aquatic invertebrates and insects. Chronic hazard levels of concern are exceeded by most uses for endangered fish and invertebrates and are potentially exceeded for certain uses for threatened birds, mammals, amphibians and reptiles.

Use of malathion in the Bay Area is of particular concern for the California red-legged frog, California tiger salamander, Delta smelt and Pacific salmon. Reported use of malathion in the Bay Area from 1999 to 2003 was over 32,000 pounds.[58] However, the San Francisco Estuary Project estimated that actual Bay Area use of malathion in 2003 alone was 200,000 pounds, when only 4,473 pounds were reported.[59] Thus, actual use of malathion in the Bay Area from 1999 to 2003 may have approached over one million pounds.

Mancozeb

Mancozeb is a fungicide for which most products have been cancelled in the U.S., but it is still being used. Mancozeb has an endocrine disrupting effect and its transformation product is a carcinogen and suspected mutagen. Mancozeb has high to very high immediate toxicity for fish and long-term toxicity inhibits germination of pollen in some plants. Use of mancozeb in the Bay Area is of particular concern for the California red-legged

frog. Reported use of mancozeb in the Bay Area from 1999 to 2003 was over 228,000 pounds.

Methamidophos

Methamidophos is a restricted-use insecticide used on cotton, potatoes and tomatoes. Methamidophos is highly toxic to pollinators, which are exposed to direct treatment on blooming crops. Endangered species levels of concern are exceeded for birds, mammals, reptiles, amphibians, and freshwater and estuarine invertebrates. Use of methamidophos in the Bay Area is of particular concern for the California red-legged frog. Reported use of methamidophos in the Bay Area from 1999 to 2003 was over 6,100 pounds.

Methomyl

Methomyl is an insecticide used on field, vegetable and orchard crops, turf, livestock quarters, commercial premises and refuse containers. Methomyl, which can contaminate surface waters as a result of spray drift or runoff, poses acute risks to birds and mammals that feed on short and tall grasses, broadleaf plants, and small insects. The major concerns for non-target organisms are chronic risks to mammals and freshwater invertebrates. Risks to aquatic invertebrates are likely to occur wherever methomyl is used. Reported use of methomyl in the Bay Area from 1999 to 2003 was over 53,000 pounds.

Methyl-Parathion

Methyl-parathion is a restricted-use insecticide used on agricultural crops, particularly cotton. Acute and chronic effects on birds, mammals, bees, and aquatic invertebrates are likely to occur as a result of application of methyl-parathion. Use of methyl-parathion in the Bay Area is of particular concern for the peregrine falcon. Reported use of methyl-parathion in the Bay Area from 1999 to 2003 was over 26,000 pounds.

Metolachlor

Metolachlor is a broad spectrum herbicide used for general weed control and is the second most widely used herbicide in the U.S. Acute as well as chronic exposures to non-target organisms can result from direct applications, spray drift and runoff. Levels of concern are exceeded at certain applications for acute and chronic effects to endangered bird and mammal species eating short grass, and for freshwater fish in shallow water bodies. Metalochlor has been found to adversely affect the growth and development of juvenile fish at low level concentrations. Reported use of metalochlor in the Bay Area from 1999 to 2003 was over 37,000 pounds.

Naled

Naled is an insecticide primarily used to control mosquitoes and is also used on food and feed crops, in greenhouses and in pet flea collars. Naled poses acute and chronic risk to endangered birds, mammals and aquatic organisms. Use of naled in the Bay Area is of particular concern for the California red-legged frog. Reported use of naled in the Bay Area from 1999 to 2003 was over 6,100 pounds.

Oxyflourfen

Oxyfluorfen is an herbicide used on tree and vine crops, and to control broadleaf and grassy weeds. Oxyfluorfen exceeds the endangered species levels of concern for terrestrial plants for all uses, for birds and mammals at some applications, and for freshwater fish and invertebrates. Use of oxyfluorfen in the Bay Area is of particular concern for Pacific salmon. Reported use of oxyfluorfen in the Bay Area from 1999 to 2003 was over 148,000 pounds.

Permethrin

Permethrin is a pyrethroid insecticide with a known endocrine disrupting effect. It is highly toxic to fish, marine invertebrates and honeybees. Permethrin also poses a risk to some endangered terrestrial invertebrates. Although it degrades rapidly and does not tend to persist in the environment, permethrin has been detected in surface water. Use of permethrin in the Bay Area is of particular concern for the California red-legged frog, San Francisco garter snake, California clapper rail and salt marsh harvest mouse. Reported use of permethrin in the Bay Area from 1999 to 2003 was over 113,000 pounds.[60] However, the San Francisco Estuary Project estimated that actual Bay Area use of permethrin in 2003 alone was 30,000 pounds, when only 23,500 pounds were reported.[61] Thus the actual use of permethrin in the Bay Area from 1999 to 2003 may have approached 144,000 pounds.

Phosmet

Phosmet is a broad-spectrum insecticide used primarily on commercial tree and vine fruit. High rate and frequency of application can lead to acute and chronic risk to terrestrial and aquatic species and residues can pose chronic and acute risks to birds and mammals. Phosmet has very high acute toxicity to freshwater fish and freshwater and estuarine/marine invertebrates. Phosmet is also very highly toxic to bees and displays extended residual toxicity. The EPA voluntarily cancelled certain uses of phosmet in 2001. Use of phosmet in the Bay Area is of particular concern for the California red-legged frog. Reported use of phosmet in the Bay Area from 1999 to 2003 was over 62,000 pounds.

Pyrethrins

Pyrethrins are natural insecticides produced from the chrysanthemum plant. Pyrethrins are extremely toxic to aquatic life such as fish and tadpoles and are toxic to beneficial insects such as honeybees. Reported use of pyrethrins in the Bay Area from 1999 to 2003 was about 2,500 pounds.[62] However, the San Francisco Estuary Project estimated that actual Bay Area use of pyrethrins in 2003 alone was 10,000 pounds, when only 482 pounds were reported.[63] Thus actual use of pyrethrins in the Bay Area from 1999 to 2003 may have approached 50,000 pounds.

Triclopyr

Triclopyr is an organochlorine herbicide. The immediate toxicity of triclopyr is medium for birds and low to high for fish. Triclopyr has been detected in groundwater and its long-term effects include a suspected carcinogen and mutagen for mammals. Use of triclopyr in the Bay Area is of particular concern for the California red-legged frog and Pacific salmon. Reported use of triclopyr in the Bay Area from 1999 to 2003 was over 98,000 pounds.

Trifluralin

Trifluralin is an herbicide used on a variety of food crops and residential sites. Most uses were cancelled in the U.S. in 1982, but it is still being used. The EPA is concerned about the exposure of threatened and endangered plant and animal species to trifluralin, since endangered species levels of concern are exceeded for birds, mammals, and semi-aquatic and aquatic plants. Trifluralin has been detected in groundwater and in surface water. Trifluralin has an endocrine disrupting effect and is a suspected carcinogen and mutagen. The immediate toxicity of trifluralin is very high for amphibians and high to very high for fish and crustaceans. Use of trifluralin in the Bay Area is of particular concern for the California red-legged frog and Pacific salmon. Reported use of trifluralin in the Bay Area from 1999 to 2003 was over 77,000 pounds.

Pesticide Use Threatens the Survival of Bay Area Endangered Species

Even though pesticide use is high in the San Francisco Bay Area, investigations into potential consequences lag far behind. Potential exposure risk for some Bay Area species can be determined from California Department of Pesticide Registration data which overlay pesticide use information with endangered species habitat information.[64] It is clear that pesticides are finding their way into ecosystems throughout the Bay Area and that many wildlife species are exposed to them in numerous ways. Although the impacts to species on the verge of extinction are often difficult to determine, the presence of pesticides at toxic levels in areas used by species listed as threatened or endangered under the Endangered Species Act potentially threatens their survival.

There are currently 51 federally endangered or threatened animal species that occur in the nine San Francisco Bay Area Counties. The USFWS, National Marine Fisheries Service (NMFS) and/or the EPA acknowledge that at least 30 of these federally listed species may be adversely affected by pesticide use. Unfortunately, for many of these species, the EPA has done nothing to limit or otherwise mitigate pesticide use in endangered species habitat in its process of registering pesticides. By failing to consult with the USFWS and NMFS, which have the statutory authority and responsibility to cooperate with other agencies in assessing impacts of agency actions and authority on threatened and endangered species, the EPA neglects to comply with federal law or even develop the information base for making the wise and cautious decisions about our most endangered wildlife.

San Francisco Bay and Delta Fish Species

Photo by: Daniel Gotshcall

North American Green Sturgeon

(*Acipenser medirostris*)
Bay Area Occurrence: San Francisco Bay and Sacramento-San Joaquin Delta
State Status: None
Federal Status: Proposed Threatened, 2005

The green sturgeon is one of the most ancient fish species in the world, remaining unchanged in its appearance since it first emerged 200 million years ago. Green sturgeon are among the largest and longest living species found in freshwater, living up to 70 years, reaching 7.5 feet in length, and weighing up to 350 pounds. These ancient fish have snouts like shovels and mouths like vacuum cleaners that are used to siphon shrimp and other food from sandy depths.

Although the effects of toxic substances from heavy metals to pesticides on green sturgeon are unknown, NMFS has determined that high exposure levels are possible and there is some degree of risk from contaminants for green sturgeon in the Sacramento River and the San Francisco Bay and Delta.[65] Long-lived adult sturgeon may accumulate contaminants through the food chain, which could interfere with reproduction.[66]

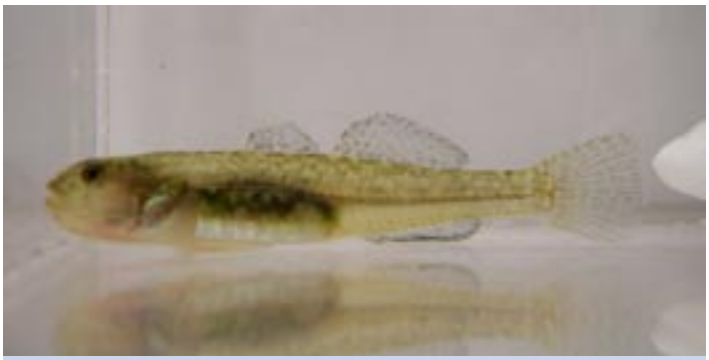


Photo by: Greg Goldsmith, U.S. Fish and Wildlife Service

Tidewater Goby (*Eucyclogobius newberryi*)

Bay Area Occurrence: Marin, Sonoma and San Mateo Counties; extirpated from Contra Costa, Alameda and San Francisco Counties
State Status: Species of Special Concern
Federal Status: Endangered, 1994

The tidewater goby is a small fish that inhabits coastal brackish water along the coast of California. The USFWS is concerned about high diazinon levels that can cause water column toxicity in lagoons that are tidewater goby habitat, noting that some creeks in Marin County are considered by the State Water Resources Control Board (SWRCB) to be "Water Quality Limited" due to diazinon in urban runoff.[67] From 250,000 to one million pounds of diazinon were used from 1999 to 2003 in the Bay Area.[68]

Photo by: P.B. Moyle, The Native Fish Conservancy

Delta Smelt (*Hypomesus transpacificus*)
Bay Area Occurrence: Solano and Contra Costa Counties
State Status: Threatened, 1993
Federal Status: Threatened, 1993

The Delta smelt is a nearly translucent steely-blue fish found only in the brackish waters from Suisun Bay upstream through the Sacramento-San Joaquin River Delta in Contra Costa, Sacramento, San Joaquin, Solano and Yolo Counties. Delta smelt spawn in backwater sloughs and along channels with tidal influence.

Delta smelt habitat in the Sacramento-San Joaquin Delta estuary receives flushes of high concentrations of agricultural pesticides such as carbofuran, chlorpyrifos, and diazinon.[69] The SWRCB lists all the important water bodies in the smelt's range as impaired by one or more contaminants, commonly including pesticides such as diazinon, chlorpyrifos, malathion, chlordane, DDT and dieldrin.[70] Up to one million pounds each of chlorpyrifos, diazinon and malathion were applied in the Bay Area from 1999 to 2003.[71]

Recent research indicates that toxicity of certain contaminants in smelt habitat occurs in episodes, often in runoff from rainstorms following periods of use of the chemicals. Acutely toxic pulses of pesticides move down the rivers and through the estuary with "remarkable persistence and relatively little dilution."[72] Researchers report episodic toxicity in winter associated with organophosphate pesticide treatment of dormant orchards; carbofuran and chlorpyrifos in the San Joaquin River and Delta in spring, possibly associated with treatment of alfalfa; rice pesticides in late spring and early summer with release of rice field water; and a variety of herbicides from irrigation tail water during the summer.[73] Peaks of numerous other chemicals, including the herbicides trifluralin and atrazine, have also been found.[74]

It is unknown what direct effect these toxins have on Delta smelt, but there is growing evidence that other fish species in the Delta are suffering direct mortality or additional stress from the presence of toxic substances. There is also evidence that the plankton upon which the smelt feed may be depleted by these highly concentrated pulses of pesticides through the Delta. The Delta's open water fish populations are mysteriously collapsing, with open water forage species including Delta smelt in severe decline. In fall of 2004, Delta smelt were at their lowest ever recorded levels.

Photo by: E.R. Keely, The Native Fish Conservancy

Coho Salmon (*Oncorhynchus kisutch*)
Bay Area Occurrence: Marin, Sonoma and San Mateo Counties
State Status: Endangered, 1995 (south of San Francisco Bay)
Federal Status: Central California Coast population[75] - Threatened, 1996

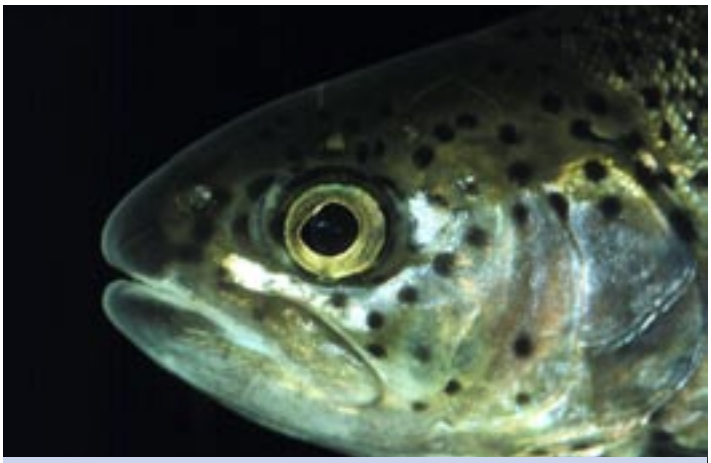


Photo by: Tom Holt

Chinook Salmon (*Oncorhynchus tshawytscha*)[76]
Bay Area Occurrence: Marin, Sonoma and Napa Counties
State Status: California Coastal – None; Central Valley Spring-Run – Threatened, 1999; Fall/Late Fall-Run – Species of Special Concern; Sacramento River Winter-Run – Endangered, 1989
Federal Status: California Coastal – Threatened, 1999; Central Valley Spring-Run – Threatened, 1999; Fall/Late Fall-Run – Candidate Species; Sacramento River Winter- Run – Endangered, 1994

Photo courtesy of National Park Service

Steelhead Trout (*Oncorhynchus mykiss*)
Bay Area Occurrence: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara and San Mateo Counties
State Status: None
Federal Status: Central California Coast Population[77] – Threatened, 1997

Pacific salmon, including endangered and threatened runs of coho salmon, chinook salmon, and steelhead trout, depend on clean water during the freshwater stages of their complex life cycles. Many runs of Pacific salmon, including those in the Bay Area and San Francisco Bay Delta, are threatened by pesticide pollution of rivers and streams within their range.[78] Pesticides have profound effects on salmon and steelhead trout and may be a significant factor in their decline. Numerous pesticides have been found in many west coast river systems in concentrations that threaten salmonid growth, development, behavior and reproduction.[79] Pesticides can impair swimming ability and avoidance of predators, cause abnormal sexual development, interfere with feeding, and disrupt the salmon's navigating abilities to return to its natal stream to spawn. Pesticides can further indirectly affect fish by changing the aquatic environment, reducing the food supply, or eliminating vegetative cover used by young salmon. The pesticides and herbicides that contaminate numerous water bodies often destroy aquatic life necessary for salmonid survival.[80]

The EPA acknowledged in pesticide registration documents that approved uses of at least 36 pesticides used in the Pacific Northwest are expected to have a negative impact on salmon. These include the organophosphate insecticides azinphos methyl, carbaryl, diazinon, and malathion, and the herbicides 2,4-D, diuron, and trifluralin.[81] For example, azinphos methyl has caused massive fish kills throughout the U.S.,[82] exposure to 2,4-D impairs trout swimming ability,[83] and trifluralin has been shown to cause bone abnormalities in salmon.[84] All of these pesticides are found in harmful concentrations in Pacific Northwest waters within the range of listed salmon species.[85] Diazinon has been found in northwest streams at levels that reduce production of testosterone by male salmon, which may weaken the chances that salmon will successfully mate.[86]

Large amounts of pesticides harmful to salmon and steelhead trout are used annually in agricultural areas in the Central Valley, concentrating in runoff that reaches the Sacramento-San Joaquin Delta and San Francisco Bay. Use of these chemicals is also prevalent in the Bay Area: from 1999 to 2003 more than one million pounds of diazinon and malathion, 424,000 pounds of diuron, 262,000 pounds of 2,4-D, 250,000 pounds of carbaryl, 98,000 pounds of triclopyr, 77,000 pounds of trifluralin and 21,000 pounds of azinphos-methyl were applied.[87]

Fishing and environmental groups recently obtained a court order preventing the use of more than 30 harmful pesticides in no-spray buffers near salmon streams in California, Oregon, and Washington. State agencies and pesticide retailers in urban areas near salmon-supporting waters must also make a point-of-sale notification available of the hazard these pesticides pose to salmonids: 2,4-D, carbaryl, diazinon, diuron, malathion, triclopyr, and trifluralin.

Tidal Marshland and Estuarine Species

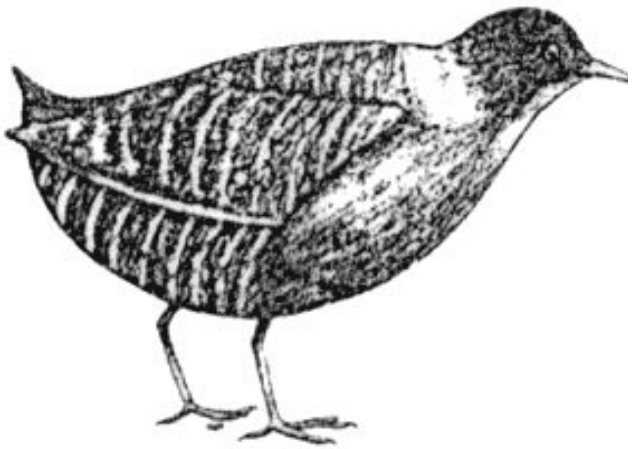
Photo by: Mike Baird

Western Snowy Plover (*Charadrius alexandrinus nivosus*)
Bay Area Occurrence: breeds in Marin, Sonoma, Napa, Alameda, Santa Clara, San Mateo and San Francisco Counties
State Status: Species of Special Concern
Federal Status: Threatened, 1993

The western snowy plover is a small shorebird that forages on invertebrates along beaches, salt marshes, salt ponds and lagoons. The Pacific coast population nests primarily on coastal

beaches from southern Washington to southern Baja California. Nests are usually built in barren or sparsely vegetated areas. Human activity and disturbance are the key factors adversely affecting snowy plover coastal breeding sites and breeding populations in California. Because snowy plovers are primarily insectivorous, feeding both on aquatic and terrestrial insects, the bioaccumulation of environmental contaminants on their nesting and wintering grounds may harm their health and reproduction.[88]

Birds are particularly susceptible to organochlorine pesticides, which can reduce egg production, cause aberrant incubation behavior, delay ovulation, poison embryos and cause mortality of chicks and adults.[89] Pesticide drift may also diminish habitat value for plovers where urban areas interface with natural habitats by reducing prey availability.[90] Spraying of the mosquitocide fenthion in Florida has killed a variety of bird species, including snowy plover and piping plover (*Charadrius melodus*).[91] The registration of fenthion was voluntarily cancelled by the manufacturer in 2003 and no use of fenthion was reported in 2003 for the seven Bay Area counties where the plover breeds.[92]



Graphic courtesy of U.S. Fish and Wildlife Service

California Black Rail (*Laterallus jamaicensis coturniculus*)

Bay Area Occurrence: Marin, Sonoma, Solano, Contra Costa and Alameda Counties
State Status: Threatened, 1971; Fully Protected
Federal Status: Candidate Species

The California black rail is a tiny, elusive bird of wetland habitats in the San Francisco Bay Area and the lower reaches of the Colorado River in California and Arizona. Once abundant in coastal California, California black rails are now restricted mostly to the tidal wetlands of the northern San Francisco Bay estuary, particularly where nesting habitat remains in San Pablo Bay. Rails eat insects, small mollusks, amphipods and other invertebrates and some seeds. Pesticides may be a hazard to rails in agricultural habitat, where applied to salt marshes, or leached into wetlands from nearby agricultural fields. Pesticides can potentially reduce the prey base for black rails, although the effects of most pesticides and contaminants on rails are poorly known.[93]

Photo by: Mike Baird

California Brown Pelican

(*Pelecanus occidentalis californicus*)
Bay Area Occurrence: Marin, Sonoma, Alameda, San Mateo and San Francisco Counties
State Status: Endangered, 1971; Fully Protected
Federal Status: Endangered, 1970

The California brown pelican is a large, grayish-brown bird with a long, pouched bill. Pelicans nest from the Channel Islands of southern California southward to coastal southern Mexico. Threats to the species include disease outbreaks, nest abandonment and disturbance at roosting sites by humans and non-native mammals, entanglement in fishing nets and hooks, and reduction in available forage fish due to El Niño events.

As a bird at the top of the food chain, brown pelicans in California experienced complete reproductive failure in the 1960s due to use of the pesticide DDT. After the ban on DDT in 1972, there has also been a corresponding increase in the eggshell thickness and reproductive success of brown pelicans. Although California breeding populations of the pelican have rebounded, persistent DDT residues in the coastal environment continue to cause chronic reproductive problems and some pelicans still show relatively high levels of pesticides in their tissues. Bioaccumulation of other water-borne contaminants is a possible threat to brown pelicans. The use of the pesticide chlorpyrifos is of concern, since a brown pelican was killed in South Carolina in 1998 due to poisoning by chlorpyrifos.[94] Up to one million pounds of chlorpyrifos were applied from 1999 to 2003 in the Bay Area; however no use was reported in proximity to California brown pelican habitat.[95]

Photo courtesy of California Department of Pesticide Regulation

California Clapper Rail (*Rallus longirostris obsoletus*)

Bay Area Occurrence: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara and San Mateo Counties; extirpated from San Francisco County
State Status: Endangered, 1971; Fully Protected
Federal Status: Endangered, 1970

The California clapper rail is a coot-sized bird that inhabits cordgrass marshes only around San Francisco Bay. The clapper rail eats invertebrates such as mollusks and crustaceans. The number of clapper rails has plummeted because of loss and degradation of tidal marsh habitat, including introduction of non-native cordgrass, and predation by non-native red foxes. The population estimate as of 1992 was only 800 to 1,000 clapper rails. The USFWS considers the clapper rail vulnerable to contaminants from urban runoff that can affect its food sources.[96] Over 130 pesticides are used in proximity to California clapper rail habitat in the Bay Area, including carbaryl, chlorothalonil, chlorpyrifos, diazinon and permethrin.[97]

Photo courtesy of U.S. Fish and Wildlife Service

California Least Tern (*Sterna antillarum browni*)

Bay Area Occurrence: breeds in Contra Costa and Alameda Counties; occurs in Santa Clara and San Mateo Counties
State Status: Endangered, 1971; Fully Protected
Federal Status: Endangered, 1970

The California least tern nests in colonies on bare or sparsely vegetated ground on isolated sand beaches, typically near estuaries, bays, or harbors where small fish are abundant. Residential and commercial development has fragmented tern habitat. Human activities and disturbance and human-enhanced populations of scavengers and predators (such as crows, domestic cats and non-native red foxes) threaten most remaining nesting colonies.

Contaminants such as organochlorine pesticides may be a factor contributing to recent declines of California least tern populations.[98] A study of related Caspian terns (*Sterna caspia*) in Elkhorn Slough in Monterey County showed that tern hatchlings from eggs contaminated by organochlorines often do not survive to adulthood.[99] Two related Forster's terns (*Sterna forsteri*) were killed in San Joaquin County in 1988 due to poisoning by the pesticide fenthion.[100] The registration of fenthion was voluntarily cancelled by the manufacturer in 2003 and there was no reported use of fenthion in the nine Bay Area counties in 2003.[101]

Photo by: Paul Kelly, Environmental Protection Agency

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*)

Bay Area Occurrence: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara and San Mateo Counties
State Status: Endangered, 1971
Federal Status: Endangered, 1970

The salt marsh harvest mouse is a small, mostly nocturnal rodent that lives in tidal and diked salt marshes only around the San Francisco Bay and its tributaries. Harvest mice have declined primarily because thousands of acres of wetlands habitat in the San Francisco Bay have been filled, degraded or converted for agricultural use. Flood control and mosquito abatement activities as well as introduced predators and competitors are also threats.

Pesticides that enter marsh habitats are also a threat to remaining harvest mouse populations.[102] Over 110 pesticides

are used in proximity to salt marsh harvest mouse habitat in the Bay Area, including carbaryl, chlorothalonil, chlorpyrifos, 2,4-D, diazinon, and permethrin.[103] The USFWS has concluded that use of eight rodenticides (brodifacoum, bromadiolone, bromethalin, chlorophacinone, cholecalciferol, diphacinone, warfarin, and zinc phosphide) in harvest mouse habitat could jeopardize the continued existence of the species,[104] but reported use of these rodenticides in the Bay Area counties where the harvest mouse occurs was minimal in 2003.[105]

Freshwater and Wetland Species

Photo by: Gerald and Buff Corsi

California Tiger Salamander

(*Ambystoma californiense*)
Bay Area Occurrence: Sonoma, Solano, Contra Costa, Alameda and Santa Clara Counties; eliminated from San Mateo and Napa Counties
State Status: Species of Special Concern
Federal Status: Threatened, 2004; Endangered in Sonoma County

The California tiger salamander is a colorful amphibian that breeds in seasonal ponds or vernal pools and is particularly susceptible to environmental contaminants. The USFWS considers exposure to toxic agricultural chemical contaminants and landscaping chemicals to be a potentially serious threat to the species, cautioning that even if toxic or detectable amounts of pesticides are not found in the breeding ponds or groundwater, "salamanders may still be directly affected, particularly when chemicals are applied during the migration and dispersal seasons."[106]

The USFWS highlighted use of pesticides thought to be particularly harmful to tiger salamanders: acephate, azinphos-methyl, chlorpyrifos, endosulfan, fenamiphos, malathion, maneb, metam sodium and methyl bromide. Salamanders can readily absorb the chemical chlorpyrifos through their permeable skins, especially when migrating through recently treated fields. Use of azinphos-methyl in the vicinity of tiger salamander habitat could directly affect salamander survival or indirectly affect their food supply. The USFWS cited studies reporting severe toxicity to amphibians from exposure to endosulfan, including extensive paralysis, delayed metamorphosis and high death rates, noting that "endosulfan is extremely toxic at low concentrations to amphibians." Use of over 1.3 million pounds of metam sodium, 1.1 million pounds of methyl bromide, 250,000 pounds of chlorpyrifos, 33,000 pounds each of acephate and maneb, 25,000 pounds of malathion, 20,000 pounds of azinphos-methyl and 9,800 pounds of endosulfan was reported from 1999 to 2003 for the five Bay Area counties where the tiger salamander occurs.[107]

Photo by: Brad Alexander, California Herps

Santa Cruz Long-Toed Salamander

(*Ambystoma macrodactylum croceum*)
Bay Area Occurrence: San Mateo County
State Status: Endangered 1971; Fully Protected
Federal Status: Endangered 1967

The Santa Cruz long-toed salamander inhabits coastal woodlands and upland chaparral near breeding habitat in ponds and freshwater marshes. Long-toed salamanders spend much of their lives in underground rodent burrows. Pollution from agricultural activities and development is a threat to water quality in long-toed salamander breeding ponds.[108]

Photo by: William Flaxington © 2004

California Red-Legged Frog (*Rana aurora draytonii*)

Bay Area Occurrence: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo and San Francisco Counties
State Status: Species of Special Concern
Federal Status: Threatened, 1996

The state's largest native frog, the California red-legged frog has disappeared from more than 70 percent of its historic range in California. Habitat loss to urban development and the effects of introduced predators are the primary threats to red-legged frogs. Agricultural practices introduce pesticides into red-legged frog habitat in wetlands, ponds and streams. Since frogs are highly aquatic with little movement away from streamside habitat, herbicides, insecticides and fungicides pose hazards to aquatic life stages. Frogs are also susceptible to burrow fumigants when they are in burrows and other terrestrial retreats.

The USFWS has concluded that exposure to wind-borne agrochemicals may be an important factor in the decline of the species, noting a strong relationship between increasing levels of upwind agriculture and the percentage of extirpated California red-legged frog sites.[109] In the Sierra Nevada-Central Valley region, the percentage of upwind land in agriculture for sites where the frogs have disappeared was six and a half times greater than for sites where the frogs are still found. The USFWS noted that pesticide contamination may result in deformities, abnormal immune system functions, diseases, injury and death of red-legged frogs.

The USFWS listed 150 pesticides or herbicides of concern that are used within the same one square mile section known to be California red-legged frog sites or habitat. Twenty-five chemicals are of particular concern due to high risk to red-legged frogs, including: acephate, azinphos-methyl, carbaryl, chlorpyrifos, diazinon, dicofol, disulfoton, endosulfan, esfenvalerate, fenamiphos, glyphosate, malathion, mancozeb, methamidophos, methoprene, naled, paraquat, permethrin, phosmet, pyrethrins, strychnine, triclopyr and trifluralin.[110] Ranid tadpoles are likely to be killed or paralyzed by some herbicides such as triclopyr and insecticides such as fenitrothion.[111] Use of many of these pesticides from 1999 to 2003 was quite high in the Bay Area: more than 1.7 million pounds of glyphosate; one million pounds each of chlorpyrifos and diazinon; 250,000 pounds of carbaryl; 228,000 pounds of mancozeb; 144,000 pounds of permethrin; 98,000 pounds of triclopyr; 84,000 pounds of paraquat; 77,000 pounds of trifluralin; and 21,000 pounds of azinphos-methyl.[112]

Photo by: George E. Hansen, U.S. Fish and Wildlife Service

Giant Garter Snake (*Thamnophis gigas*)

Bay Area Occurrence: Solano and Contra Costa Counties
State Status: Threatened, 1971
Federal Status: Threatened, 1993

The giant garter snake is one of the largest garter snakes. It is endemic to wetlands in the Sacramento and San Joaquin Valleys and the San Francisco Bay Delta. Giant garter snakes are usually found in marshes, sloughs, ponds, small lakes, low gradient streams, irrigation and drainage canals, and rice fields. Conversion of wetlands for agricultural, urban and industrial development has eliminated over 90 percent of the suitable habitat for this species.

The USFWS suspects that heavy use of pesticides was a contributing factor in the decline of this once abundant species.[113] Preliminary studies have documented potential bioaccumulation effects on giant garter snakes or their prey species caused by contaminants derived from agricultural products.[114] Discharge of contaminants and pesticides into wetlands may degrade habitat and adversely affect remaining giant garter snake populations by affecting water quality and reducing prey populations.[115] The pesticide of concern,

carbofuran – which is widely used on rice in California – may harm the giant garter snake. The CDPR has published stewardship guidelines for rice growers in an attempt to reduce risk to giant garter snakes.[116] Over 8,300 pounds of carbofuran were reported applied from 1999 to 2003 in Solano and Contra Costa Counties.[117]

Photo courtesy of U.S. Fish and Wildlife Service

San Francisco Garter Snake

(*Thamnophis sirtalis tetrataenia*)
Bay Area Occurrence: San Mateo County
State Status: Endangered, 1971; Fully Protected
Federal Status: Endangered, 1967

The most beautiful serpent in North America, the San Francisco garter snake has a broad greenish-yellow stripe on its back, bordered by black and red stripes on each side and a distinctive greenish-blue or turquoise-blue belly. Adults can grow to a length of two to three feet. All known populations of this snake occur in San Mateo County near freshwater marshes, ponds, and slow-moving streams along the coast.

The San Francisco garter snake may be threatened by pesticide use on private lands where it still occurs. The USFWS has noted that pesticides are a threat to other aquatic garter snakes in California.[118] Pesticides used in proximity to San Francisco garter snake habitat in the Bay Area include carbaryl, carbofuran, chlorothalonil, chlorpyrifos, diazinon, dinocap and permethrin.[119] Use of over 52,000 pounds of these pesticides was reported _for San Mateo County from 1999 to 2003.[120]

Photo by: Larry Serpa

California Freshwater Shrimp (*Syncaris pacifica*)

Bay Area Occurrence: Marin, Sonoma and Napa Counties
State Status: Endangered, 1980
Federal Status: Endangered, 1988

California freshwater shrimp are found only in low elevation perennial streams or intermittent streams with perennial pools in the northern San Francisco Bay Area. Freshwater shrimp require low gradient streams with diverse habitat structure including undercut banks, exposed roots, woody debris and overhanging vegetation. Among other factors, shrimp populations and habitat are threatened by inadvertent introduction of herbicides and pesticides into creek water through aerial drift, spills and runoff.[121] Freshwater shrimp may also be sensitive to pesticides commonly used in vineyards. Over 85 pesticides are used in proximity to California freshwater shrimp habitat in the Bay Area, including chlorpyrifos, diazinon and diuron.[122]

Photo by: Dr. David H. Kavanaugh © California Academy of Sciences

Delta Green Ground Beetle (*Elaphrus viridis*)

Bay Area Occurrence: Solano County
State Status: None
Federal Status: Threatened, 1980

The Delta green ground beetle is a small metallic green and golden predaceous beetle associated with vernal pool habitats and seasonally wet pools. The species most likely historically occurred throughout much of the Central Valley, though it currently only remains in two vernal pools in Solano County. Elimination of vernal pool habitat due to development, tilling for crops, or tapping pools for irrigation have caused the decline of this species. Poorly managed grazing and crowding out of native vegetation by introduced plants are ongoing threats.

The USFWS believes that use of herbicides and pesticides in transportation right of ways or grazing areas may adversely impact Delta green ground beetles or their habitat.[123]

Terrestrial Species

Photo by: George Jameson, U.S. Geological Service

Swainson's Hawk (*Buteo swainsoni*)
Bay Area Occurrence: Solano, Contra Costa and Alameda Counties
State Status: Threatened, 1983
Federal Status: None

The Swainson's hawk is a medium sized hawk found in the Central Valley and eastern Bay Area Counties. Swainson's hawks primarily hunt small rodents, but will also take birds and insects. Most Swainson's hawk territories are in riparian zones adjacent to suitable grassland foraging habitats and nests are commonly in large mature trees. The loss of suitable agricultural land and grassland habitat to residential and commercial developments is the major threat to the species. A recent threat has been massive pesticide poisoning of Swainson's hawks and their prey animals on their wintering grounds in South America. About 20,000 Swainson's hawks were poisoned in Argentina during the winter of 1995-1996 by the pesticide monocrotophos, which has long been banned in the U.S. and was finally banned in Argentina in March of 2000.

The California Department of Fish and Game cautions that the potential toxic effects of rodenticides used in agricultural lands on Swainson's hawks must be monitored.[124] Swainson's hawks can be adversely impacted by poisoning of prey animals, organophosphate and carbamate insecticide contamination in agricultural fields during times of the year when insects are the main prey, and potential bioconcentration of contaminants up the food chain. For example, poisonings of dozens of Swainson's hawks were documented in Texas in the 1990s due to disulfoton and terbufos, pesticides that were used on corn and cotton.[125] The Texas hawks had fed on insects that had in turn been feeding on the plants with pesticide residues. However, there was no reported use of terbufos and negligible use of disulfoton in 2003 in the three Bay Area counties where the Swainson's hawk occurs.[126]


Photo by: Sidney Maddock

American Peregrine Falcon (*Falco peregrinus anatum*)
Bay Area Occurrence: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo and San Francisco Counties
State Status: Endangered, 1971; Fully Protected
Federal Status: Endangered, 1970; De-Listed, 1999

The peregrine falcon is one of the swiftest birds of prey, swooping down and catching smaller birds in flight. Peregrines nest and winter in a variety of habitats, including wetlands, woodlands, forests, cities, agricultural lands and coastal areas.

Nesting sites require protective cliffs or ledges, and in urban areas some pairs nest on buildings and bridges.

The American peregrine falcon is an endangered species success story. Organochlorine pesticides such as DDT were the primary cause of the rapid and significant decline in the number of American peregrine falcons in most of North America between the 1940s and 1970s.[127] DDT's principal breakdown product, DDE, accumulates in the tissues of species at the top of the food chain, such as peregrine falcons, and causes thin-shelled eggs and other complications. DDE interferes with calcium deposition during shell formation, resulting in the production of thin-shelled eggs that are easily crushed during incubation. Due to an EPA ban on the use of DDT in the United States in 1972, the environmental residue levels of DDE have steadily decreased in most areas. Peregrine numbers have increased since the banning of DDT, and in 1999 the USFWS de-listed the species.[128]

However, peregrines and other birds at the top of the food chain are still at risk from pesticides. The legal pesticide dicofol, which is widely used in California agriculture, contains small amounts of DDT as a manufacturing byproduct.[129] A 1996 study of related prairie falcons (*Falco mexicanus*) in Pinnacles National Monument, Mount Diablo, and Goat Rock in central California revealed hatching failures similar to those observed 20 years earlier for DDT-contaminated eggs, attributed to ingestion of contaminated prey (birds, reptiles and small mammals) from nearby agricultural areas in the Salinas Valley.[130] Concentrations of DDE in falcon eggs at Pinnacles were two to six times higher than the levels known to cause hatching failures. The study showed that no falcon chicks successfully hatched from the three nests with the highest concentrations of DDE or the pesticide of concern, lindane, over a three-year sampling period. Over 15,000 pounds of dicofol and minimal amounts of lindane were applied in the Bay Area from 1999 to 2003.[131] Peregrine falcons have been killed recently in other parts of the U.S. by acute poisoning from other pesticides of concern, such as carbofuran, methyl parathion and strychnine.[132] Use of over 9,700 pounds of carbofuran and 26,900 pounds of methyl parathion was reported in the Bay Area from 1999 to 2003 and over 70 pounds of strychnine were applied in 2003 alone.[133]

Photo by: Dr. Lloyd Glenn Ingles © California Academy of Sciences

San Joaquin Kit Fox (*Vulpes macrotis mutica*)
Bay Area Occurrence: Contra Costa, Alameda and Santa Clara Counties
State Status: Threatened, 1971
Federal Status: Endangered, 1967

The San Joaquin kit fox is the smallest member of the dog family in North America, with an average weight of about five pounds. San Joaquin kit foxes inhabit grasslands in the San Joaquin Valley and eastern Bay Area Counties. In the eastern Bay Area, kit foxes mostly prey on California ground squirrels. Kit foxes either dig their own dens or use dens constructed by other animals. The primary threat to kit foxes is the loss and degradation of suitable habitat due to agricultural, industrial and urban developments.

Hundreds of San Joaquin kit foxes were destroyed in the past by strychnine-poisoned bait used for coyote control. The federal government began controlling use of rodenticides in 1972 and prohibited above-ground application of strychnine within the range of the kit fox in 1988. However, use of 28 pounds of strychnine was reported in 2003 for pest control in the East Bay counties where the kit fox occurs.[134] Intensive agricultural use in the Central Valley still exposes kit foxes to a wide array of pesticides and rodenticides.

The USFWS has determined that use of some burrow fumigants (aluminum and magnesium phosphide), anticoagulant rodenticides (chlorophacinone, diphacinone and pival), and gas cartridges (potassium nitrate and sodium nitrate) in kit fox habitat could jeopardize the species.[135] More than 22,000 pounds of aluminum phosphide was reported used from 1999 to 2003 in the East Bay counties where the kit fox occurs.[136] At least 27 San Joaquin kit foxes were killed from poisoning recently in the Central Valley and two were poisoned in 1992 in the East Bay, primarily by the rodenticides brodifacoum, chlorophacinone and bromadiolone.[137] Brodifacoum is a deadly rodenticide widely available to the public as an active

ingredient in rat and mouse baits such as Talon, Havoc and D-Con.

Pesticides and rodenticides may indirectly affect the survival of kit foxes by reducing abundance of their staple prey species.[138] For example, California ground squirrels, the staple prey of kit foxes in the northern portion of their range, were eliminated from Contra Costa County in 1975 by extensive rodent eradication programs. This severely reduced kit fox abundance through secondary poisoning and elimination of prey.[139]

Photo by: Gary A. Beeman

Alameda Whipsnake (*Masticophis lateralis euryxanthus*)

Bay Area Occurrence: Contra Costa, Alameda and Santa Clara Counties
State Status: Threatened, 1971
Federal Status: Threatened, 1997

The Alameda whipsnake is a slender snake with black dorsal coloring and distinctive yellow-orange racing stripes down each side. Adult whipsnakes grow from three to four feet in length. Whipsnakes are extremely fast moving and hold their heads high off the ground in a cobra-like manner while hunting for potential prey, which includes lizards, small mammals, snakes and nesting birds. Alameda whipsnakes occupy disappearing northern coastal scrub and chaparral habitats broken by grassland and rocky hillsides, primarily in Contra Costa and Alameda Counties. Whipsnake habitat has been severely reduced and fragmented by urban sprawl, road construction, livestock grazing and fire suppression.

The USFWS is concerned about exposure to rodenticides, herbicides and pesticides adversely affecting the Alameda whipsnake directly or indirectly through prey reduction or habitat alteration.[140]

Photo courtesy of www.WeForAnimals.com

Lange's Metalmark Butterfly

(*Apodemia mormo langei*)
Bay Area Occurrence: Contra Costa County
State Status: None
Federal Status: Endangered, 1976

The Lange's metalmark butterfly is found only at the Antioch Dunes National Wildlife Refuge in Contra Costa County, which was established primarily for the butterfly's protection. Metalmark butterfly larvae depend upon their food plant, naked-stemmed buckwheat (*Eriogonum nudum*). When adult butterflies emerge in late summer they have one week to feed, mate and locate the host buckwheat on which to deposit their eggs. The species declined in the early 1900s when the dunes were heavily mined for sand and their habitat has been further impacted by construction, agriculture, trampling by humans, fire and changes in dune structure that have reduced reproduction of the host buckwheat plants. The USFWS is concerned about pesticide use in the area that has the potential to drift onto the Refuge and also affect potential pollinators on adjacent lands.[141]

Photo by: Charles Webber © California Academy of Sciences

Valley Elderberry Longhorn Beetle

(Desmocerus californicus dimorphus)
Bay Area Occurrence: Napa County
State Status: None
Federal Status: Threatened, 1980

The valley elderberry longhorn beetle is a colorful cylindrical beetle less than an inch long, associated with riparian elderberry trees during its entire life cycle. Riparian fragmentation and destruction due to urbanization, agricultural conversion, and waterway maintenance are the primary threats to this insect. Insecticide and herbicide use in agricultural areas and along roadsides may be factors limiting the beetle's distribution. The USFWS cautions that pesticides or herbicides should not be sprayed within 100 feet of elderberry beetle habitat.[142]

Photo by: Richard A. Arnold

Bay Checkerspot Butterfly

(*Euphydryas editha bayensis*)
Bay Area Occurrence: Santa Clara and San Mateo Counties; extirpated from Contra Costa, Alameda and San Francisco Counties
State Status: None
Federal Status: Threatened, 1987

The bay checkerspot butterfly depends upon several different host plants during its life cycle: eggs are laid on a native plantain, which the larvae feed upon; if this food is not sufficient for development the larvae may move onto owl's clover. The larvae then generally enter dormancy until the following winter, then emerge to feed again, pupating in late winter; finally the adults emerge shortly thereafter.

Populations of bay checkerspots historically occurred in numerous areas around the San Francisco Bay including the San Francisco peninsula, the mountains near San Jose, the Oakland hills, and several spots in Alameda County. Most of these have been eliminated due to explosive urban development; populations now remain only in San Mateo and Santa Clara counties.

Pesticides have contributed to reduced numbers of bay checkerspots, and application or drift of pesticides may also affect their critical habitat.[143] Precautions may be needed for pesticide use on California oakworm or other pests near bay checkerspot localities.[144] Over 60 pesticides are used in proximity to Bay checkerspot butterfly habitat in the Bay Area, including chlorothalonil, chlorpyrifos and diazinon.[145]

Photo by: Andrew Sanchez © California Acedemy of Sciences

Mission Blue Butterfly

(Icaricia icariodes missionensis)
Bay Area Occurrence: Marin, San Mateo and San Francisco Counties
State Status: None
Federal Status: Endangered, 1976

Formerly relatively widespread throughout the San Francisco and Marin peninsulas, the mission blue now remains at only a few sites in the coastal counties, primarily on San Bruno Mountain in San Mateo County. Mission blue larvae are dependent on perennial lupines as their host plant. Pesticides of concern chlorothalonil and diazinon are used in proximity to mission blue butterfly habitat.[146]

Photo courtesy of San Bruno Mountain Watch

San Bruno Elfin Butterfly

(*Incisalia mosii bayensis*)
Bay Area Occurrence: San Mateo County
State Status: None
Federal Status: Endangered, 1976

San Bruno elfin butterflies inhabit rocky outcrops and cliffs only in the coastal scrub on the San Francisco peninsula. The butterflies are dependent upon stonecrop (*Sedum spathulifolium*) as a host plant. San Bruno elfin butterfly larvae have a mutualistic association with ants. The larvae excrete a sweet honeydew liquid to attract ants, which provide protection from predators and parasites. The largest San Bruno elfin butterfly occurs on San Bruno Mountain, where management includes reducing pesticide use. The USFWS recovery plan for the species urged cutting back use of herbicides.[147] Over 60 pesticides are used in proximity to San Bruno elfin butterfly habitat on the San Francisco peninsula, including chlorothalonil, chlorpyrifos and diazinon.[148]

Photo courtesy of San Bruno Mountain Watch

Callippe Silverspot Butterfly

(*Speyeria callippe callippe*)
Bay Area Occurrence: Alameda and San Mateo Counties; extirpated from Contra Costa and San Francisco Counties
State Status: None
Federal Status: Endangered, 1997

Photo courtesy of U.S. Fish and Wildlife Service

Behren's Silverspot Butterfly

(*Speyeria zerene behrensii*)
Bay Area Occurrence: extirpated from Sonoma County
State Status: None
Federal Status: Endangered, 1997

Photo courtesy of National Park Service

Myrtle's Silverspot Butterfly (*Speyeria zerene myrtleae*)

Bay Area Occurrence: Marin and Sonoma Counties
State Status: None
Federal Status: Endangered, 1992

These three silverspot butterflies, so named because of silver spots or scales on the undersides of their wings, are found only in the San Francisco Bay Area or coastal northern California. All are dependent upon native violets (*Viola* spp.) as their host and food plant. The callippe silverspot is primarily orange, tan and brown above. Historically, callippe silverspots inhabited grasslands throughout much of the northern San Francisco Bay region. Populations of this butterfly now remain only at two sites on grasslands in the Bay Area. Behren's silverspot has golden brown and orange wings, dappled with brown spots and bands. Behren's silverspot historically ranged from the

Russian River in Sonoma County north to Point Arena in southern Mendocino County, but now remains in only a single population at Point Arena. Myrtle's silverspot was formerly widespread on the San Francisco and Marin peninsulas, but now only four populations remain in northern coastal Marin County, in dunes, scrub, and grasslands habitats.

Larvae of the *Speyeria* genus, the silverspots, are extremely sensitive to pesticides and can even be killed by accumulation of runoff in the soil after pesticide spraying.[149] All of these butterflies are susceptible to mortality from pesticide use in proximity to occupied habitat, and use of herbicides in the vicinity of butterfly food plants needs to be carefully controlled to prevent drift.[150] Over 50 pesticides are used in proximity to callippe silverspot butterfly habitat in the San Francisco Bay Area, including chlorpyrifos and diazinon.[151]

Plants

The following federally or state listed Bay Area plant species are either known or suspected to be adversely affected by use of herbicides or pesticides:

Sonoma Alopecurus (*Alopecurus aequalis* var. *sonomensis*)[152]
Bay Area Occurrence: Marin and Sonoma Counties
State Status: None
Federal Status: Endangered, 1997

Pallid Manzanita (*Arctostaphylos pallida*)[153]
Bay Area Occurrence: Contra Costa and Alameda Counties
State Status: Endangered, 1979
Federal Status: Threatened, 1998

Marsh Sandwort (*Arenaria paludicola*)[154]
Bay Area Occurrence: Extirpated from San Francisco County
State Status: None
Federal Status: Endangered, 1993

Coastal Dunes Milk-Vetch (*Astragalus tener* var. *titi*)[155]
Bay Area Occurrence: Monterey County
State Status: Endangered, 1982
Federal Status: Endangered, 1998

Sonoma Sunshine (*Blennosperma bakeri*)[156]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1992
Federal Status: Endangered, 1991

White Sedge (*Carex albida*)[157]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1979
Federal Status: Endangered, 1997

Tiburon Indian Paintbrush (*Castilleja affinis* ssp. *neglecta*)[158]
Bay Area Occurrence: Marin, Napa and Santa Clara Counties
State Status: Threatened, 1990
Federal Status: Endangered, 1995

Robust Spineflower (*Chorizanthe robusta*)[159]
Bay Area Occurrence: Extirpated from Alameda, Santa Clara and San Mateo Counties
State Status: None
Federal Status: Endangered, 1994

Sonoma Spineflower (*Chorizanthe valida*)[160]
Bay Area Occurrence: Marin County; extirpated from Sonoma County
State Status: Endangered, 1990
Federal Status: Endangered, 1992

Fountain Thistle (*Cirsium fontinale* var. *fontinale*)[161]
Bay Area Occurrence: San Mateo County
State Status: Endangered, 1979
Federal Status: Endangered, 1995

Suisun Thistle (*Cirsium hydrophilum* var. *hydrophilum*)[162]
Bay Area Occurrence: Solano County
State Status: None
Federal Status: Endangered, 1997

Presidio Clarkia (*Clarkia franciscana*)[163]
Bay Area Occurrence: Alameda and San Francisco Counties
State Status: Endangered, 1978
Federal Status: Endangered, 1995

Vine Hill Clarkia (*Clarkia imbricata*)[164]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1978
Federal Status: Endangered, 1997

Soft Bird's-Beak (*Cordylanthus mollis* ssp. *mollis*)[165]
Bay Area Occurrence: Napa, Solano and Contra Costa Counties
State Status: Rare, 1979
Federal Status: Endangered, 1997

Pennell's Bird's-Beak (*Cordylanthus tenuis* ssp. *capillaries*)[166]
Bay Area Occurrence: Sonoma County
State Status: Rare, 1978
Federal Status: Endangered, 1995

Baker's Larkspur (*Delphinium bakeri*) and **Yellow Larkspur** (*Delphinium luteum*)[167]
Bay Area Occurrence: Marin and Sonoma Counties
State Status: Rare, 1979
Federal Status: Endangered, 2000

Photo by: (c) 1997 Doreen L. Smith

Showy Indian Clover

Photo by: (c) 2000 Doreen L. Smith

Baker's Larkspur

Photo by: Robert Potts (c) California Academy of Sciences

Pitkin Marsh Lily

Photo by: Emily Roberson

Burke's Goldfields

Santa Clara Valley Dudleya (*Dudleya setchellii*)[168]
Bay Area Occurrence: Santa Clara County
State Status: None
Federal Status: Endangered, 1995

San Mateo Wooly Sunflower (*Eriophyllum latilobum*)[169]
Bay Area Occurrence: San Mateo County
State Status: Endangered, 1992
Federal Status: Endangered, 1995

Marin Dwarf Flax (*Hesperolinon congestum*)[170]
Bay Area Occurrence: Marin, San Mateo and San Francisco Counties
State Status: Threatened, 1992
Federal Status: Threatened, 1995

Santa Cruz Tarplant (*Holocarpha macradenia*)[171]
Bay Area Occurrence: all natural populations extirpated from Marin, Sonoma, Contra Costa and Alameda Counties; successfully reintroduced in Contra Costa County
State Status: Endangered, 1979
Federal Status: Threatened, 2000

Burke's Goldfields (*Lasthenia burkei*) and **Sebastopol Meadowfoam** (*Limnanthes vinculans*)[172]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1979
Federal Status: Endangered, 1991

Contra Costa Goldfields (*Lasthenia conjugens*)[173]
Bay Area Occurrence: Napa, Solano, Contra Costa and Alameda Counties; extirpated from Santa Clara County
State Status: None
Federal Status: Endangered,1997

Pitkin Marsh Lily (*Lilium pardalinum* ssp. *pitkinense*)[174]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1978
Federal Status: Endangered, 1997

Sebastopol Meadowfoam (*Limnanthes vinculans*)[175]
Bay Area Occurrence: Sonoma County; extirpated from Napa County
State Status: Endangered, 1979
Federal Status: Endangered, 1991

Few-Flowered Navarretia (*Navarretia leucocephala* ssp. *pauciflora*)[176]
Bay Area Occurrence: Napa County
State Status: Threatened, 1990
Federal Status: Endangered, 1997

Many-Flowered Navarretia (*Navarretia leucocephala* ssp. *plieantha*)[177]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1979
Federal Status: Endangered, 1997

Colusa Grass (*Neostapfia colusana*)[178]
Bay Area Occurrence: Solano County
State Status: Endangered, 1979
Federal Status: Threatened, 1997

Calistoga Popcornflower (*Plagiobothrys strictus*)[179]
Bay Area Occurrence: Napa County
State Status: Threatened, 1990
Federal Status: Endangered, 1997

North Coast Semaphore Grass (*Pleuropogon hooverianus*)[180]
Bay Area Occurrence: Marin and Sonoma Counties
State Status: Threatened, 2002
Federal Status: None

Napa Bluegrass (*Poa napensis*)[181]
Bay Area Occurrence: Napa County
State Status: Endangered, 1979
Federal Status: Endangered, 1997

Hickman's Cinquefoil (*Potentilla hickmanii*)[182]
Bay Area Occurrence: San Mateo County
State Status: Endangered, 1979
Federal Status: Endangered, 1998

Kenwood Marsh Checkerbloom (*Sidalcea oregana* ssp. *valida*)[183]
Bay Area Occurrence: Sonoma County
State Status: Endangered, 1982
Federal Status: Endangered, 1997

Metcalf Canyon Jewelflower (*Streptanthus albidus* ssp. *albidus*)[184]
Bay Area Occurrence: Santa Clara County
State Status: None
Federal Status: Endangered, 1995

Showy Indian Clover (*Trifolium amoenum*)[185]
Bay Area Occurrence: Marin County; extirpated from Sonoma, Napa and Solano Counties
State Status: None
Federal Status: Endangered, 1997

Crampton's Orcutt Grass (*Tuctoria mucronata*)[186]
Bay Area Occurrence: Solano County
State Status: Endangered, 1979
Federal Status: Endangered, 1978

What is the EPA Doing to Control the Use of Pesticides?

The Pesticide Registration Process

The Environmental Protection Agency (EPA) is responsible for the oversight of pesticide sales and use in the United States. Specifically, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) charges the EPA with reviewing and registering chemicals for use as insecticides, fungicides, rodenticides, and pesticides in the U.S.[187] A new pesticide generally may not be sold or used in the U.S. unless the EPA has registered it for that particular use. In recognition of rapid advancements in scientific understanding of the effects of pesticides, Congress amended FIFRA in 1988, establishing a comprehensive re-registration program for all pesticides with active ingredients that were initially registered before November 1, 1984.

The EPA may register a pesticide only after making the following determinations: (1) the labeling complies with FIFRA's requirements; (2) the composition claims are warranted; (3) the pesticide will perform its intended function; and (4) the pesticide will not cause unreasonable adverse effects on the environment. The culmination of the registration process is the EPA's approval of a label for the particular pesticide, which then may not be used in a manner inconsistent with that label. The EPA must classify pesticides for general or restricted use, depending on their particular risks. Where necessary to guard against unreasonable adverse environmental effects, the EPA must classify (or when the information becomes available, reclassify) a pesticide as "restricted." Restricted use pesticides may only be applied by a certified applicator or under the direct supervision of a certified applicator, and application must follow all limitations on the frequency, type, location or protective measures associated with its use.

Even after registering a pesticide, the agency retains discretionary involvement in and control over that registration. The EPA must periodically review registrations with a goal of reviewing each one every 15 years. The EPA also has the authority to compel registrants to submit data on potentially unreasonable adverse effects that may be necessary for a re-registration review and can cancel pesticide registrations whenever "a pesticide or its labeling or other material required to be submitted does not comply with the provisions of this Act or, when used in accordance with widespread and commonly recognized practice, generally causes unreasonable adverse effects on the environment."[188]

The EPA's re-registration decisions require a determination of whether the pesticide causes unreasonable adverse effects to people or the environment when used according to product labeling. This determination is presented in a Re-registration Eligibility Decision (RED) document. The RED comprises a human health and environmental risk assessment. The FIFRA risk-benefit standard is not a safety standard, but rather a balancing standard under which, in the EPA's own words, workers can be regularly exposed to "unacceptable risks." The environmental assessment evaluates the likelihood that exposure to that pesticide may cause harmful ecological effects. The effects can be direct (e.g. fish die from a pesticide entering waterways), or indirect (e.g. birds become sick or do not reproduce normally after ingesting contaminated fish). The studies conducted during the environmental assessment include: defining the chemical properties of the pesticide; determining how the pesticide behaves in the environment; and assessing its impact on plants and animals not targeted by the pesticide (non-target organisms). Toxicology studies are carried out on plants and animals that have been chosen for testing because they broadly represent non-target organisms. EPA toxicology studies analyze both acute (short-term) and chronic (long-term) impacts, however the impacts analysis is limited to actual mortality of plants and animals as a result of exposure to the pesticide. Although the EPA's risk assessments are comprehensive with respect to what they cover, many important ecological effects of pesticides are not considered.

To determine how the pesticide behaves in the environment, the EPA measures the interaction of the pesticide with soils, air, sunlight, surface water and groundwater. Some of the basic questions that must be answered to determine the "environmental fate" of the pesticide include: how fast and by what means does the pesticide degrade; what are the breakdown chemicals; how much of the pesticide or its breakdown chemicals will travel from the application site; and where will the pesticide or its breakdown chemicals accumulate in the environment. Environmental fate analyses help develop estimates of pesticide concentrations in the environment. The EPA establishes the risk assessment by comparing possible exposures to a pesticide, based on the environmental fate analyses, with resulting harmful effects on plants and animals. The result will indicate the likelihood of mortality to plants and animals from use of the pesticide. However, the risk assessment does not incorporate sub-lethal impacts under its risk assessment evaluation.

In determining the ecological risk posed by a pesticide (risk characterization), the EPA integrates the results of the exposure and eco-toxicity data to estimate the likelihood of adverse ecological effects. The means of integrating the results of exposure and eco-toxicity data is called the quotient method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates (estimated environmental concentrations or EECs) by eco-toxicity values (toxicity endpoint values, such as the median lethal dose (LD50) or the median lethal concentration (LC50), both acute and chronic. RQs are then

compared to the EPA's levels of concern (LOCs). The LOCs are criteria used by the EPA to indicate potential risk to non-target organisms. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms.

LOCs address the following risk presumption categories: (1) *acute high* – potential for acute risk is high and regulatory action may be warranted in addition to restricted use classification; (2) *acute restricted use* – the potential for acute risk is high, but may be mitigated through restricted use classification; (3) *acute endangered species* – endangered species may be adversely affected; and (4) *chronic risk* – the potential for chronic risk is high and regulatory action may be warranted. Generally, a higher RQ is cause for greater concern. Calculated risk quotients represent a screening level assessment. Risk characterization provides further information on the likelihood of adverse effects occurring by considering the fate of the chemical in the environment, geographic patterns of chemical usage, communities and species potentially at risk, their spatial and temporal distributions, and the nature of the effects observed in the laboratory and field studies. When the RQ exceeds the LOC for a particular category, the EPA presumes a risk of concern to that category.

The types of measures included in Re-registration Eligibility Decisions (REDs) to reduce risks that are of concern include: voluntary cancellation of pesticide products or deletion of uses; declaring certain uses ineligible or not yet eligible (and then proceeding with follow-up action to cancel the uses or require additional supporting data); restricting use of products to certified applicators; limiting the amount or frequency of use; improving use directions and precautions; adding more protective clothing and equipment requirements; requiring special packaging or engineering controls; requiring no-treatment buffer zones; employing groundwater, surface water or other environmental and ecological safeguards; and other measures.

The EPA also regulates the use of pesticides through the Federal Food, Drug, and Cosmetic Act (FFDCA), which authorizes the EPA to set tolerance levels for pesticides used in or on foods or animal feed. In 1996, Congress further amended FIFRA and the FFDCA and unanimously passed the Food Quality Protection Act (FQPA), which refined safety standards for pesticide residue in food. The EPA had previously established food tolerances for pesticides based on adult men's consumptions and susceptibility to adverse health effects. However, the National Academy of Sciences found that children consume different foods in greater quantities than adults, are more vulnerable to adverse health effects due to their growth and development, and are particularly vulnerable to endocrine disruptors that can affect growth and sexual maturation. The FQPA directed the EPA to revamp its tolerance-setting studies to account for children's consumption patterns and vulnerabilities and to provide additional safeguards while those data gaps are being filled.

In the past, the EPA has acted as if no adverse impact would occur while missing studies were being conducted and initial indications of adverse effects had not been conclusively proven. Under the FQPA, additional protection must be provided in the interim. The FQPA also established deadlines to complete the long languishing tolerance and re-registration processes. Under FQPA, the EPA must further determine with "reasonable certainty that no harm" will come to infants, children or other sensitive individuals exposed to pesticides from food, water, and home and garden use. The FQPA requires that the EPA consider the cumulative effects of different pesticides in evaluating the safety of individual pesticides; however, this does not apply to occupational exposure to pesticides. The FQPA also established a prioritization scheme for reviewing pesticides, under which the first priority group of pesticides to be reviewed by EPA will be organophosphate pesticides, a group of closely-related pesticides that affect the functioning of the nervous system.

After the EPA has issued a RED and declared a pesticide re-registration case eligible for re-registration, individual end-use products that contain pesticide active ingredients included in the case still must be re-registered. This concluding part of the re-registration process is referred to as "product re-registration." In issuing a completed RED document, the EPA calls in any product-specific data and revised labeling needed to make final re-registration decisions for each of the individual pesticide products covered by the RED.

EPA's Responsibilities under the Endangered Species Act

When a species has been listed as threatened or endangered under the Endangered Species Act (ESA), federal agencies have duties under the ESA to assess their programs and activities to ensure they do not jeopardize the survival and recovery of the animal or plant in question. The ESA prescribes the process to be followed to ensure compliance with each set of duties. Section 7(a)(2) of the ESA requires that "each federal agency shall, in consultation with and with the assistance of the [Interior] Secretary, insure that any action authorized, funded, or carried out by such agency … is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary . . . to be critical."

The ESA establishes an inter-agency consultation process to assist federal agencies in complying with this duty under Section 7. Federal agencies must consult with the appropriate

expert fish and wildlife agency: the U.S. Fish and Wildlife Service (USFWS) for terrestrial species and non-oceanic fish species, and National Marine Fisheries Service (NMFS) for marine species to determine whether their actions will jeopardize the survival or adversely modify the critical habitat of listed species and, if they do, to identify ways to modify the action to avoid that result. An agency must initiate consultation under Section 7 whenever it undertakes an action that "may affect" a listed species or critical habitat. Conversely, an agency is relieved of the obligation to consult on its actions only when the action will have "no effect" on listed species or designated critical habitat. Effects determinations are based on the direct, indirect, and cumulative effects of the action when added to the environmental baseline and other interrelated and interdependent actions.

Regulations implementing Section 7 broadly define the scope of agency actions subject to consultation to encompass "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies," including the promulgation of regulations and the granting of licenses. Agencies must consult on ongoing agency actions over which the federal agency retains, or is authorized to exercise, discretionary involvement or control. Agencies must also consult on ongoing agency actions "if a new species is listed … that may be affected by the identified action."[189] The end product of formal consultation is a biological opinion in which The USFWS or NMFS determines whether the action will jeopardize the survival and recovery of listed species or will adversely modify the species' critical habitat. In order to make this determination, the USFWS or NMFS must review all relevant information and provide a detailed evaluation of the action's effects, including the cumulative effects of federal and nonfederal activities in the area, on the listed species.

The USFWS and NMFS have a statutory duty to use the best available scientific information in an ESA consultation. If the USFWS or NMFS determines that the action is likely to jeopardize the species, the biological opinion must specify "reasonable and prudent" alternatives that will avoid jeopardy. The USFWS or NMFS must also formulate discretionary conservation recommendations to reduce or minimize the action's impacts on listed species or critical habitat. Not only does a Section 7 consultation assist the action agency in discharging its duty to avoid jeopardy, but the biological opinion also affects the agency's obligation to avoid the "take" of listed species. Under Section 9 of the ESA, it is illegal for any person – whether a private or governmental entity – to "take" without authorization any endangered species of fish or wildlife listed under the ESA. By regulation, The USFWS has made the take prohibition applicable to all threatened species.

"Take" is defined to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in such conduct. The USFWS and NMFS have defined "harm" to include "significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering."[190] As part of a consultation, The USFWS or NMFS determines whether to authorize the incidental take of listed species through the issuance of an incidental take statement. An incidental take statement may be issued only if the action can proceed without causing jeopardy. An incidental take statement must: (1) specify the impact of the incidental take on the listed species, (2) specify reasonable and prudent measures the USFWS or NMFS considers necessary to minimize that impact, and if necessary (3) set forth mandatory terms and conditions.

An incidental take statement insulates the federal agency from liability for take of a threatened or endangered species, provided the agency complies with the statement's terms and conditions. This permission to take a species extends to any entity receiving a federal permit, license, authorization or funding subject to, and in compliance with, the statement. Thus, the ESA provides that: "[A]ny taking that is in compliance with the terms and conditions specified in a written statement provided under subsection (b)(4)(iv) of this section shall not be considered to be a prohibited taking of the species concerned."[191]

Beyond Section 7 consultation duties, federal agencies must "utilize their authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered species and threatened species listed" under the ESA. As defined under Section 3 of the ESA, the term "conservation" means to use all necessary methods and procedures to bring an endangered or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary. As a federal action agency, the EPA must review the programs it administers and consult with the expert fish and wildlife agencies to ensure it utilizes its programs and authorities to conserve listed species – especially in light of the agency's pesticide registration responsibilities.

EPA's Failure to Adequately Evaluate Risks to Wildlife

The Clean Water Act requires the EPA to develop "aquatic life criteria" (ALC) for specific pollutants to determine water quality and risk to aquatic life from water contamination. ALC are supposed to accurately reflect the latest scientific knowledge since they provide guidance to states and tribes in adopting water quality standards and are the basis for regulating discharges or releases of pollutants. The EPA has established few ALC for the thousands of registered pesticides. Nonetheless, U.S. Geological Survey (USGS) sampling has found that ALC values are frequently exceeded in streams nationwide.

The EPA's ALC most likely underestimate pesticide impacts to aquatic organisms. ALC do not address chronic exposure to pesticide amalgamations or mixtures and fail to take into account possible additive or synergistic effects of more than one pesticide or combinations of pesticides, much less pesticide transformation products. Combinations of two or three pesticides, which are commonly found in the environment at low levels, can be up to 1,600 times more powerful in their impact on hormones than any of the pesticides individually. Some chemicals, which individually do not disrupt hormones, greatly magnify the ability of other chemicals to disrupt hormones. ALC do not address the prevalence or toxicity of pesticide breakdown products, which can be found at higher levels and can persist much longer than the parent compounds. ALC do not address the strong seasonality of concentration patterns (resulting in repeated pulses of high concentrations). ALC do not evaluate some types of biological effects such as endocrine disruption.

The EPA's pesticide risk assessments are also fundamentally flawed for numerous reasons. Problematically, the risk assessment screenings are based on effects to organisms and not to habitat, ignoring indirect and chronic effects. The risk assessments only address active ingredients of a pesticide, failing to take into account degradate products. While the EPA's models do address multiple applications of the same pesticide by the same landowner for pest control prescribed by the label, they do not capture multiple users and uses of the same pesticide that impact the same water body or area of land. The models fail to incorporate site-specific conditions such as water temperature, pH, changes in precipitation and climate. The assessments fail to address impacts of inert or other ingredients of the pesticide. The EPA models also do not consider species distribution or density, number of species actually exposed, or the concentration and duration of exposure.

Of particular concern is how the EPA estimates the toxicity levels for species. Because their toxicity levels are based on the median lethal concentration, the EPA's determination of allowable pesticide levels is based on mortality and not on potential adverse impacts – while "may affect" is the relevant trigger for consultations prescribed by the ESA. Consequently, the EPA's ecological risk assessments fail to adequately assess sub-lethal effects that harm listed species. These failures, and a misunderstanding of cause and effect, result in numerous invalid and unlawful effects determinations.

USFWS has repeatedly raised serious concerns about harm to listed species from specific pesticides and inadequacies in the EPA's risk assessments for ESA purposes. One example of the EPA's failure to regulate pesticides harmful to endangered species is their consultation with the USFWS on re-registration of the insecticide endosulfan. A letter sent by the USFWS in 2002 to the EPA stated that "EPA's discussion of the USFWS's biological opinion on endosulfan use is inadequate. It fails to mention that jeopardy opinions were provided in 1989 on those pesticides used for 43 species, including fish and mussel species, as well as the Santa Cruz long-toed salamander, Wyoming toad, Nashville crayfish, piping plover and wood stork. EPA failed to adopt nine of the 13 reasonable and prudent actions to avoid jeopardy . . . . EPA may be in violation of the Endangered Species Act."[192] The letter concludes: "the U.S. Fish and Wildlife Service does not support the re-registration of endosulfan." The USFWS further informed the EPA that "we do not believe that EPA has adequately evaluated or presented the ecological risks of this pesticide . . . . In the event that EPA proceeds with this registration, we believe that sufficient information exists to assume this pesticide is likely to result in numerous adverse effects to threatened and endangered species." As of 2004 the EPA had registered 103 products with endosulfan for general use and approximately 60 special uses. As discussed in this report, endosulfan has been implicated in population declines or is a threat to numerous listed amphibians such as the California red-legged frog and California tiger salamander.

Unfortunately, there are many other examples of the EPA's failure to address USFWS concerns and to regulate pesticide use accordingly. For instance, the USFWS strongly urged that all uses of diazinon be restricted or cancelled due to its high toxicity to wildlife, yet the EPA failed to implement prescriptions from a 1989 USFWS biological opinion finding diazinon use jeopardizes the existence of 80 listed species.[193] In another case, USFWS identified serious data gaps in the EPA review of ecological impacts of atrazine, concluding: "it does not appear that EPA will be able to fulfill its legal responsibilities under [the ESA]."[194] And in another example, the USFWS strongly disagreed with an EPA exemption allowing use of carbofuran, which was cancelled in 1991 due to bald eagle kills.[195]

EPA's So-Called "Endangered Species Protection Program"

The EPA displays a stunning lack of initiative in complying with the Endangered Species Act. The agency has shown reckless disregard for the impact of its Pesticide Regulation Program on wildlife, and most importantly, on endangered species. The EPA has made occasional forays in addressing pesticide registrations through ESA consultation, but each attempt has failed to fully assess the impact of the pesticide program on endangered species. More importantly, the EPA has failed to implement an effective overarching program to address pesticide impacts to endangered species, abrogating its responsibility to further conservation of threatened and endangered species as required by Section 7(a)(1) of the ESA.

In 1972, the EPA assumed authority for registration of pesticides from the U.S. Department of Agriculture, and in the wake of the publication of Rachel Carson's *Silent Spring*, environmental standards were written into FIFRA. Pesticides already in use were supposed to be brought into compliance with these standards but were not, leading to the EPA's later re-registration process and deadlines. Pesticides originally registered in the 1950s and 1960s are still awaiting re-registration under FIFRA's environmental standards. Congress passed the ESA in 1973 but the EPA did not begin consultations under the ESA with the USFWS for pesticides until 1981. Consultations were conducted on a case-by-case basis where an individual pesticide was consulted on for specific uses. Recognizing that the case-by-case approach was inefficient, the EPA adopted a "cluster" approach where pesticides with similar use patterns were considered together. This approach began in 1983 with a series of biological opinions covering corn, grain, forest, mosquito and rangeland uses.

In 1989, the EPA reinitiated consultation on the pesticides reviewed in the clusters, focusing on impacts to aquatic species. Additionally, in 1989, the EPA released a proposed "Endangered Species Protection Program" (ESPP),[196] which would establish how future consultations would take place. In 1993, the EPA found that the "cluster" approach was also problematic and adopted a species-based approach where they evaluated the impacts of 16 vertebrate control agents (i.e. rodenticides) on 56 species (mammals, birds, reptiles and insects). The EPA intended to consult on another 15 pesticides but the biological opinion was never completed. After 1993, the EPA continuously referred to the non-finalized 1989 ESPP, deferring ESA compliance until it was finalized.

The EPA's view was that previous opinions proved ineffective in assessing impacts of pesticides and thus an overarching framework was necessary. Consequently, instead of complying with the ESA as pesticides continued to be registered and new species continued to be added to the federal endangered species list, the EPA provided generic statements that it would address ESA issues when the ESPP was finalized. Of course, each year the EPA claimed it expected the ESPP to be finalized soon. In the interim, the agency relied on only partially-implemented voluntary measures to protect species that received consultation up to 1993. Although there have been numerous determinations by the USFWS that registered use of pesticides would jeopardize listed species and many Incidental Take Permits have been granted with pesticide use conditions for conserving listed species, the EPA has taken no action – not even the minimum step of developing a county bulletin that would lay out voluntary protections.

Since 1993, except in the presence of litigation, the EPA has not completed a single consultation for newly listed species or addressed new scientific information regarding previously consulted species. In fact, the EPA has not submitted sufficient information to USFWS or NMFS to even start a consultation on pesticide impacts to any listed species. In contrast to the EPA are federal land management agencies, which have completed ESA consultations with the USFWS on their use of pesticides in noxious weed control programs on federal lands. The land management agencies have imposed far greater pesticide restrictions than required by the EPA registration and label, which has enabled the USFWS to have greater assurance that listed species would not be jeopardized.

In the interim – while the EPA continues to fail to comply with the ESA – species have continued to be exposed to potentially harmful pesticides with no assessment of the consequences. During its consultation period with the EPA in the mid-1980s to early 1990s, the USFWS concluded that pesticides jeopardized birds, amphibians, mammals, aquatic invertebrates, fish and reptiles in dozens of "jeopardy" determinations. The consultations found that registered pesticides jeopardized the continued existence of over 100 species, yet the EPA continuously deferred any ESA consultation until the ESPP was finalized.

After years as a proposed voluntary program, the EPA finalized the ESPP in November 2005. The revised ESPP describes the EPA's approach to implementing its responsibilities under section 7(a)(2) of the ESA, while at the same time not placing an unnecessary burden on agriculture and other pesticide users. However, the ESPP program is only implicated when the EPA makes a subsequent determination that geographically specific risk mitigation is necessary to protect federally listed threatened or endangered species or their critical habitat. If geographically specific pesticide use limitations are necessary, the EPA will then create a bulletin containing enforceable use limitations for the pesticide. Bulletins will be referenced on the pesticide product label and available on the EPA Web site. The problems with the primary provisions of the finalized ESPP are as follows:

(1) The pesticide label will not specify restrictions necessary to protect endangered species. Rather, to learn what restrictions are required for a given pesticide, pesticide users will need to consult a Web site or call a toll-free number.
(2) The EPA will establish protections for endangered species as part of its regular pesticide review process, in which each pesticide is reviewed only once every 15 years. Since the EPA is now completing congressionally mandated registrations of most pesticides currently on the market, it will postpone endangered species protections for another 10-15 years and leave imperiled species at risk.
(3) Unfortunately, the EPA has declined to institute monitoring of endangered species impacted by pesticides and it will make only selective use of surface water monitoring undertaken by the USGS, states and tribes.

(4) The EPA will give chemical companies and pesticide users special rights to comment on any proposed restrictions on pesticide uses and the EPA will strive to minimize burdens on pesticide users. The EPA will exclude the public from these special reviews, and places no comparable emphasis on ensuring that endangered species receive the most effective (as opposed to the least burdensome) protection from harmful pesticides.

In comments on the proposed ESPP, conservationists called for use restrictions to be placed directly on the pesticide label or to be distributed along with the product at the point of sale. They also called for the EPA to take swift action to develop and implement restrictions for the most harmful pesticides, pointing to a giant loophole in the new program – a 15-year delay in establishing much-needed protections for endangered fish and wildlife from pesticides. This comes on the heels of a recent bill that passed in the House that would exempt pesticides from the ESA for a period of five years. Conservationists have faulted the program as being sorely inadequate to ensure compliance with restrictions on pesticide use and call it a "don't ask-don't tell" program because information on pesticide restrictions will be hidden on the EPA's Web site rather than communicated directly to pesticide users.

The EPA assumes it can solve the pesticide problem for endangered species through the use of "county bulletins." Under the ESPP, generic label statements will instruct pesticide users to consult local county bulletins, which inform the user on how to appropriately apply the pesticide in proximity to endangered and threatened species. Some county bulletins were created after the 1989 consultation to provide protections for species covered in the 1989 biological opinion. Specifically, the bulletins contained the 1989 biological opinion's reasonable and prudent alternatives to avoid jeopardy. However, the EPA admits that these bulletins are totally outdated as they only provide use instructions for a few species listed prior to 1993, have not incorporated use limitations for species listed since 1993, and are used in only a select number of states across the country. Although the EPA never updated the original set of county bulletins, created to implement the mitigation measures deemed necessary by the USFWS in the 1989 biological opinion, the EPA stated in the 2002 proposed ESPP that county bulletins will be updated annually.

Given the EPA's proven inability to manage a very small number of bulletins covering a limited number of species, it is difficult to believe that the EPA will be able to adequately protect endangered species through the use of county bulletins. Consequently, those species whose survival is jeopardized by pesticide use receive no real protections and will continue to decline towards extinction while the EPA continues to find ways to avoid compliance with the ESA.

EPA's New Regulations Weakening Endangered Species Protections

In July 2004 the Bush administration adopted new regulations that circumvent the consultation process established under the ESA to ensure that federally permitted pesticide applications will not wipe out endangered species. The new rules, promulgated by the USFWS and NMFS at the chemical industry's behest, reveal the EPA's ongoing interest is avoiding its ESA obligations rather than finding a way to bring its pesticide registration program into compliance with the ESA.

The new regulations will weaken endangered species protections primarily by shutting federal wildlife agency experts out of endangered species protection, instituting "self-consultations" in which only the EPA assesses the potential for pesticide impacts on endangered species. The regulations will also make it more difficult to protect endangered species by requiring a greater show of harm to species before formal consultations with wildlife agency experts are required and by deferring to the EPA's assessments of pesticides and views even where the EPA lacks essential data and species expertise. The regulations allow outdated science to be the basis for determining whether – and the extent to which – endangered species must be protected from pesticides. They also give the chemical industry special participation rights that are not shared by the public.

A USFWS technical team of biologists and toxicologists conducted an extensive review of the EPA's proposed risk assessment process under the new regulations. The technical team found significant deficiencies, specifically that EPA risk assessments will likely underestimate exposures and risks of pesticides to listed species due to gaps in data on sub-lethal effects, inert ingredients, mixtures, numerous species, "incorrect" risk thresholds, and limited models that overlook various scenarios, such as shallow waters, shorelines, inhalation exposure from soil fumigants, and skin exposures for frogs. The team recommended updating the science underlying the EPA's approach to incorporate additional species and effects in the EPA's tests and analysis, to expand the use of peer-review literature, and to ground the analysis of pesticides impacts in the biological and ecological needs of listed species. The team concluded that until such changes are made, the EPA's risk assessments would not use the best science, consider all relevant aspects of pesticide impacts, or ensure against jeopardy to listed species. In response, the Bush administration disbanded the team and the federal wildlife agencies signed off on the EPA's risk assessment process despite persistent concerns and scathing critiques from technical team members.

The EPA is poorly equipped to take on consultations without oversight by wildlife agency experts. Although EPA staff may have a strong understanding of pesticides, the agency does

not have expertise about listed species and cannot, therefore, make requisite effect determinations absent the USFWS or NMFS. In a nod to industry, this inadequate process allows opportunities for pesticide manufacturers to contribute to the risk assessment while limiting the opportunity of the USFWS and NMFS to provide oversight.

Wildlife agency experts have repeatedly called into question the EPA's assessments of the impacts of pesticides on fish and wildlife. For example, the USFWS comments on EPA's atrazine risk assessment stated: "Risk assessments that fail to address [the pesticide mixing] issue are likely to underestimate the true potential for ecological impacts, and as such, this represents a critical data gap that EPA needs to address." NMFS and FWS have criticized the EPA for failing to account for sub-lethal effects in its risk assessments and registration of pesticides.[197] For example, NMFS stated in its 2002 biological opinion on pesticide use on public forests that "Rainbow trout behavior changed at chlordane (organo-chlorine insecticide) concentrations below the EPA's not-to-be-exceeded concentration, illustrating the inadequacy of using current EPA application guidelines for avoidance of sublethal effects." The EPA's own assessment of the pesticide diazinon acknowledged that the EPA lacked knowledge about young chinook salmon life cycles and habitat needs. Furthermore, the EPA's ability to assess the risks pesticides pose to salmon have been called into question in letters from NMFS in which the overarching conclusions were that the EPA's pesticide assessments were not based on the best scientific information and may be biased toward concluding that a pesticide does not pose an ecological risk to listed resources, when in fact it does."[198]

By eliminating the checks and balances built into the ESA through formal agency consultation, the new rule makes it easier for agribusiness and other industries to use highly toxic pesticides. These changes to the way pesticides are regulated under the ESA will have severe and detrimental effects to many endangered species in the San Francisco Bay Area if they are allowed to stand. Scientists, conservationists and members of Congress oppose the rule change, which the administration formulated with the help of the pesticide industry. Sixty-six members of Congress wrote a letter to the Bush administration opposing the new pesticide regulations, including Bay Area Congressional members Barbara Lee, George Miller, Mike Thompson, Zoe Lofgren, Tom Lantos and Lynn Woolsey. In September 2004 a coalition of conservation and fishing groups filed a lawsuit challenging the new pesticide consultation regulations.

The EPA and the Courts

Due to the EPA's ongoing recalcitrance in complying with the ESA, many environmental organizations have been forced to seek recourse in the courts. The following is a brief review of resolved and pending lawsuits over the EPA's neglect of endangered species that occur in the San Francisco Bay Area.

Washington Toxics Coalition, et al. v. EPA

Concerned about the impacts pesticides pose to endangered west coast salmon and steelhead trout species, the Northwest Coalition for Alternatives to Pesticides, Washington Toxics Coalition, Pacific Coast Federation of Fishermen's Associations, and Institute for Fisheries Resources sued the EPA in January 2001 for failing to complete ESA Section 7 consultations with NMFS for over 50 toxic pesticides found in salmon waters. While the EPA had made initial determinations for the pesticides, NMFS found that the information provided and analyzed by the EPA was insufficient for consultations because of serious gaps.

In July 2002, the U.S. District Court in Seattle found that the EPA had failed to meet its Section 7 obligations, noting that the EPA's own reports document the potentially significant risks posed by registered pesticides to salmonids. Based on EPA reports for 54 pesticides, the Court found that the EPA failed to consult on the potential impacts of these pesticides on salmon. The EPA was ordered to comply with the ESA by evaluating, with the input of NMFS, the effects of these 54 pesticides on endangered and threatened salmon.

In July and August 2003, the Court ruled that interim protective measures should be put in place while the EPA was completing this process. In January 2004, the Court imposed buffers that restrict the use of 38 pesticides near salmon streams and required point-of-sale warnings on products containing seven pesticides that have polluted urban salmon streams.

In 2004, the pesticide industry group CropLife America, along with other agricultural interests, attempted five times to stay the January 2004 injunction while they appealed the ruling with the District Court and eventually the Ninth Circuit Court of Appeals. The District Court issued a strongly worded opinion denying the industry request. Lambasting the EPA, the Court stated that "if EPA had expended as much effort in compliance with the ESA as it has expended in resisting this action, the lawsuit might have been unnecessary." The 9th Circuit Court affirmed the injunction in full and the Supreme Court turned down the CropLife request for judicial review. Bay Area endangered species affected by the court ruling are steelhead trout, coho salmon and chinook salmon.

Californians for Alternatives to Toxics, et al. v. EPA

In 2000, Californians for Alternatives to Toxics, the Environmental Protection Information Center, and the Humboldt Watershed Council sued the EPA for failing to consult with the USFWS and NMFS before registering pesticides that may affect six listed salmonids and 33 listed plant species or their critical habitats in California. The plaintiffs settled the lawsuit in November 2002 with a consent decree, which established deadlines for the EPA to initiate consultation on the potential effects of 18 pesticides (acrolein, atrazine, bromacil, carbaryl, chlorpyrifos, diazinon, diuron, glyphosate, hexazinone, imazapyr, oxyfluorfen, 2,4-D-2 ethylhexyl ester, molinate, oryzalin, simizine, sulfometuron-methyl, triclopyr butoxyethyl ester, and triclopyr triethylammonium). The EPA was required to consult with the federal wildlife agencies for all 18 pesticides by February 2005. Bay Area endangered species affected by the consent decree are steelhead trout, coho salmon and chinook salmon.

Center for Biological Diversity v. Whitman

In April 2002, the Center for Biological Diversity sued the EPA for failing to consult on pesticides that may affect the California red-legged frog. The suit identified over 250 pesticides that are used in red-legged frog habitat. Numerous scientific studies have definitively linked pesticide use with significant developmental, neurological and reproductive effects on amphibians. Pesticide contamination can cause deformities, abnormal immune system functions, diseases, injury and death of red-legged frogs and other amphibians. In September 2005, the U.S. District Court in San Francisco ruled that the EPA violated the ESA by registering pesticides for use without considering how these pesticides might impact the continued existence of the red-legged frog and ordered the EPA to review the impacts these pesticides have on the frog "at the earliest possible time." The EPA must now consult with the USFWS on the impacts of 66 of the most toxic and persistent pesticides authorized for use in red-legged frog habitat in California.

Natural Resources Defense Council v. EPA

The Natural Resources Defense Council (NRDC) sued the EPA in August 2003 for failing to consult on the impact of the herbicide atrazine on numerous listed species. Although the lawsuit focuses on the EPA's failure to protect sea turtles in the Chesapeake Bay, salamanders in Texas, mussels in Alabama, and sturgeons in Midwest waters from atrazine, the outcome will have a bearing on many Bay Area endangered species affected by atrazine use. Although atrazine is banned in much of Europe, the EPA refuses to ban the herbicide in the U.S. even though its risk assessments acknowledge potential harmful effects of atrazine – both directly and indirectly – on endangered fish, aquatic invertebrates, terrestrial plants and aquatic plants.

A recent University of California study demonstrated that frog larvae exposed to extremely low doses (0.01 parts per billion) of atrazine resulted in the production of hermaphrodites.[199] However, the EPA concluded that it is not possible to determine the relationship of atrazine exposure to developmental effects in amphibians. The EPA's independent Scientific Advisory Panel (SAP) reviewed the literature on developmental effects of atrazine on amphibians and responded to the EPA's conclusion. The SAP noted that although it could not draw a conclusion regarding a concentration-response relationship, it believes that the data support the hypothesis that the effect of atrazine on amphibian gonad development occurs with a threshold concentration between 0.01 and 25 parts per billion.[200]

In a shocking move, the EPA ignored the overwhelming scientific evidence on the harmful effects of atrazine, and in October 2003 approved the unrestricted use of this pesticide. The EPA made a "no effect" determination for atrazine for endangered species, which is suspect and disregards the Hayes data. Under a court-approved consent decree with NRDC under another atrazine suit focused on public health concerns, the EPA was required to further assess the use of this dangerous chemical. However, in a private agreement with Syngenta, the primary producer of atrazine, the EPA required Syngenta to monitor atrazine pollution from 2004 to 2005 in only 3 percent of the 1,172 watersheds nationwide that are known to be at high risk of atrazine contamination. The EPA has not required any measures to protect the public and wildlife from atrazine use in any of these watersheds. The EPA also alarmingly concluded that atrazine is not likely to cause cancer in humans, despite the August 2003 report from the SAP, which found that atrazine may cause cancer and that the EPA's focus on prostate cancer was potentially misleading. NRDC filed a lawsuit in February 2005 challenging the EPA's illegal negotiation of secret agreements with chemical industry lobbyists over regulation of atrazine.

Washington Toxics Coalition, et al. v. U.S. Department of Interior

In September 2004, a coalition of conservation and fishing groups filed a lawsuit in federal district court in Seattle challenging the federal government's new pesticide consultation regulations. The Center for Biological Diversity joined the Washington Toxics Coalition, Defenders of Wildlife, Helping Our Peninsula's Environment, National Wildlife Federation, Natural Resources Defense Council, Northwest Coalition for Alternatives to Pesticides and Pacific Coast Federation of Fishermen's Associations/Institute for Fisheries Resources in challenging the EPA's latest attempts to eliminate important protections for endangered species in the EPA registration process.

The Bush administration's new regulations allow the EPA to evade its legal obligations and determine itself whether a pesticide harms endangered species without consulting with federal wildlife agencies. The EPA's attempt to determine whether pesticides may affect listed species through self-consultation is impermissible under the ESA and eliminates the checks and balances built into the ESA through formal agency consultation. The new rule would allow the EPA to conduct self-consultations based on deficiencies in EPA science and make it easier for agribusiness and other industries to use highly toxic pesticides.

Responding to the lawsuit, the EPA tried to ignore and conceal the widespread controversy and scientific dissension over approval of their new consultation regulations by submitting only final and official documents as the administrative record of the rulemaking. However, the federal court has ordered the EPA to provide the whole record, including internal dissent. This lawsuit is ongoing.

Recommendations

Endangered Bay Area wildlife species exposed to toxic pesticides may prove to be sentinels that that are indicative of our own fate. Pesticides that are found in wildlife habitats are also are finding their way into our drinking water, food and air. Because it can often take decades of study to know for certain the harmful consequences of expanding pesticide use, we should take a precautionary approach, and phase out use of the most dangerous pesticides, reduce our reliance on toxic chemicals for pest control and promote ecologically based pest management.

Policy Recommendations for the U.S. Environmental Protection Agency (EPA) and the Federal Government

- Require the EPA to immediately begin consultation and to commit to an aggressive consultation schedule for all registered pesticides that may affect endangered species. The EPA should abandon its delay tactics and attempts at legislative exemptions from the ESA, and request adequate funding to clear up the backlog of consultations and prioritize compliance with the ESA for all registration and re-registration of pesticides.

- Require interim safeguards for toxic pesticides known or suspected to harm endangered species, such as atrazine, carbofuran, chlorpyrifos and diazinon, prioritizing pesticides which have already been determined by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service to jeopardize any listed species. Use restrictions necessary to prevent listed species from exposure to these pesticides should be required until the EPA has consulted with the USFWS on the impacts of these pesticides. These pesticides should be not be used in known occupied habitat, designated critical habitat, or in buffer areas around habitats for federally listed species.

- Rescind the new federal regulation that allows the EPA to consult with itself and stop the EPA from circumventing the oversight of the expert fish and wildlife agencies in bringing its pesticide registrations into compliance with the Endangered Species Act.

- Revamp the EPA's so-called Endangered Species Protection Program. The current ESPP relies on vague references to county bulletins to supposedly protect endangered species. The EPA should attach real prohibitions on proximate use or aerial spraying in zones around endangered species habitat on pesticide labels as part of the registration process. The EPA should also require adequate monitoring of pesticide impacts on endangered species when registering pesticides, rather than merely identifying the need for monitoring.

- The EPA must conduct meaningful and relevant ecological risk assessments and correct scientific deficiencies in their assessments of pesticide impacts. The EPA must improve its science to require testing of actual formulations of pesticide products rather than just active ingredients in isolation, and test for sub-lethal effects of pesticides. Pesticide manufacturers must be required to conduct long-term studies on ecosystem-wide impacts to demonstrate that a pesticide has no adverse effects before allowing it to be registered. Present regulations view a pesticide as innocent until proven guilty, with detrimental impacts to environmental health. It is critical to know more about the long-term ecological effects of a pesticide before it is released into the environment.

- Rather than regulate pesticides one at a time, the EPA should develop a system of ecologically based pest management that reduces the need for toxic pesticides.

- Prohibit toxic pesticide use on National Wildlife Refuges. Enforce the mandate of the National Wildlife Refuge Improvement Act of 1997 to put wildlife first on wildlife refuges. If farming is to take place in these areas, it should be restricted to organic farming of crops that are compatible with wildlife.

Policy Recommendations for the State of California's Environmental Protection Agency

- Immediately ban statewide use of toxic pesticides most harmful to wildlife and human health. This immediate ban should apply to the most toxic pesticides for which there is known and compelling information about their hazards, such as atrazine, carbofuran, diazinon and chlorpyrifos.

- Phase out the use of all toxic pesticides that are harmful to wildlife and human health and reduce the use of other pesticides. Banning individual harmful pesticides usually results in shifting use to equally toxic substitute pesticides, with new and unknown adverse effects on wildlife. Rather than regulating pesticides one at a time the state EPA should develop a system of ecologically based pest management that reduces the need for toxic pesticides.

- Make California's current voluntary pesticide use buffers for endangered species. mandatory. The proposed buffers should be peer reviewed by federal wildlife agencies and

independent biologists to ensure they are adequate to protect listed species from toxic pesticide drift and runoff.

- Require the state of California's Department of Pesticide Regulation to live up to its mission of protecting public health and the environment and enforce existing laws and support alternative agriculture. For years the agency has consistently stonewalled enforcement of environmental regulations related to toxic pesticides and allocated few resources to alternative pest management in agriculture and other sectors.

- Provide extensive support for non-chemical methods of pest control and tax incentives to reduce toxic pesticide use. The direct cost of applying a pesticide is only a small fraction of the actual cost. Many of the costs associated with toxic pesticide use are borne by the public and the environment, such as human illness due to pesticide exposures, kills of birds and fish, loss of habitat and food for fish and wildlife, and increased crop damage due to pesticide-resistant pests. Giving growers a tax break for reducing toxic pesticide use and/or requiring pesticide manufacturers to pay more of the external costs associated with pesticide use will provide incentives to reduce use.

- Provide funding for additional monitoring of fish and wildlife populations, as well as chemical concentrations in water, sediments and wildlife tissues. Monitoring of chemical concentrations and fish and wildlife populations, including creation of a centralized system for reporting bird and fish kills, is essential for determining the long-term effects of pesticide use. Understanding pesticide effects on native species in the field, not just in the laboratory, is crucial.

Recommendations for Homeowners, Renters and Parents

The amount of pesticides used on lawns, gardens and in homes and schools is estimated to be more than one-fifth of total pesticide use in California. If you are a homeowner, renter or parent and wish to reduce your impacts on the environment while protecting your and your family's health, here are some steps you can take.

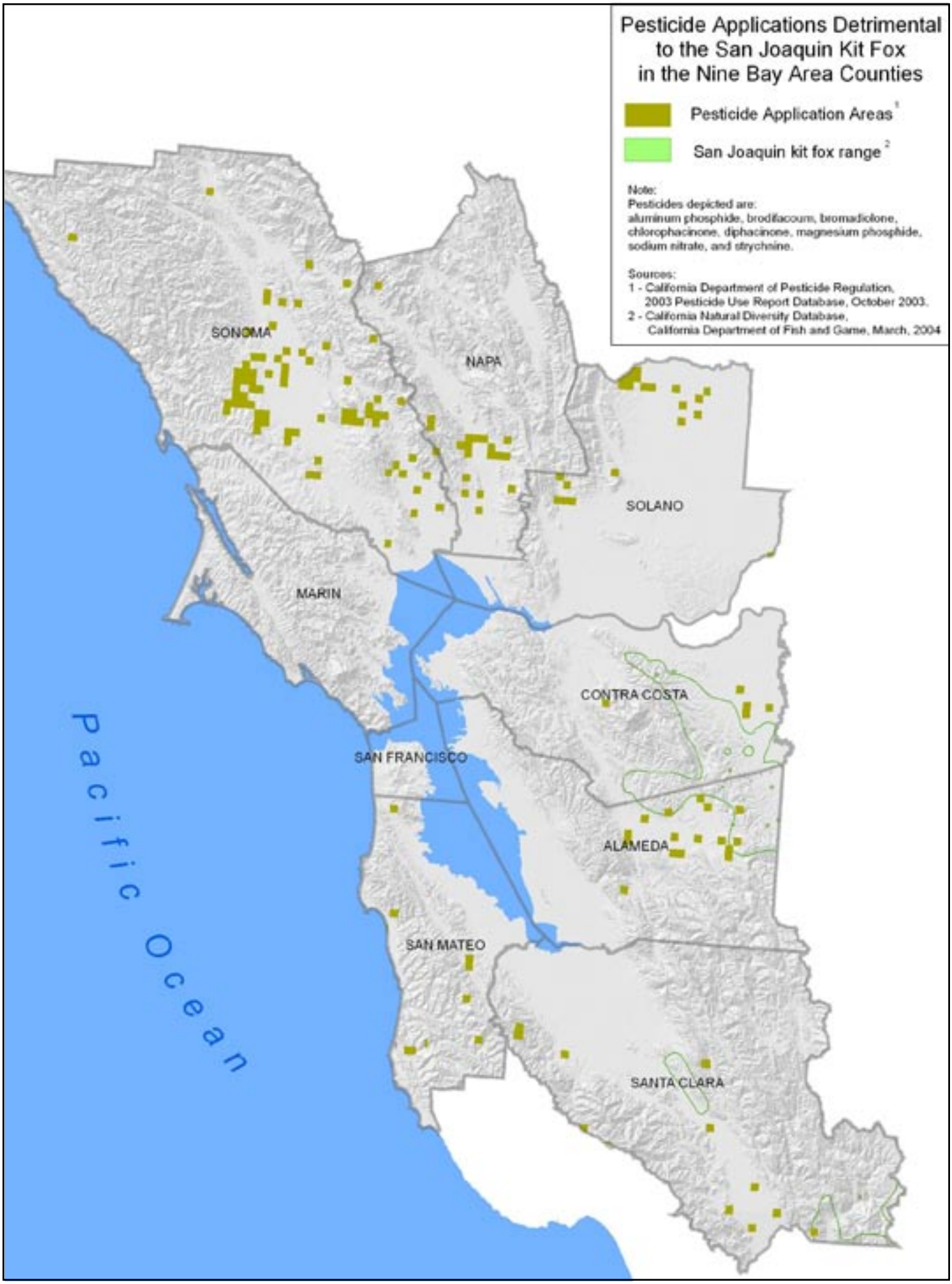
- Use least-toxic pest control methods around the home and garden. Exclude pests by caulking cracks, and keep kitchens and other parts of the home free from food sources that attract pests. Use low-toxicity, contained baits instead of spraying potent toxicants into the environment. In the garden, control weeds by mulching or hand weeding and use beneficial insects or least-toxic insecticides such as soaps, oils, and bio-pesticides to control insect pests. Watch out for "weed and feed" fertilizers containing toxic pesticides. If you hire others to do your gardening work, insist that no toxic pesticides be used or hire landscaping and pest-control firms specializing in least-toxic methods of pest management.

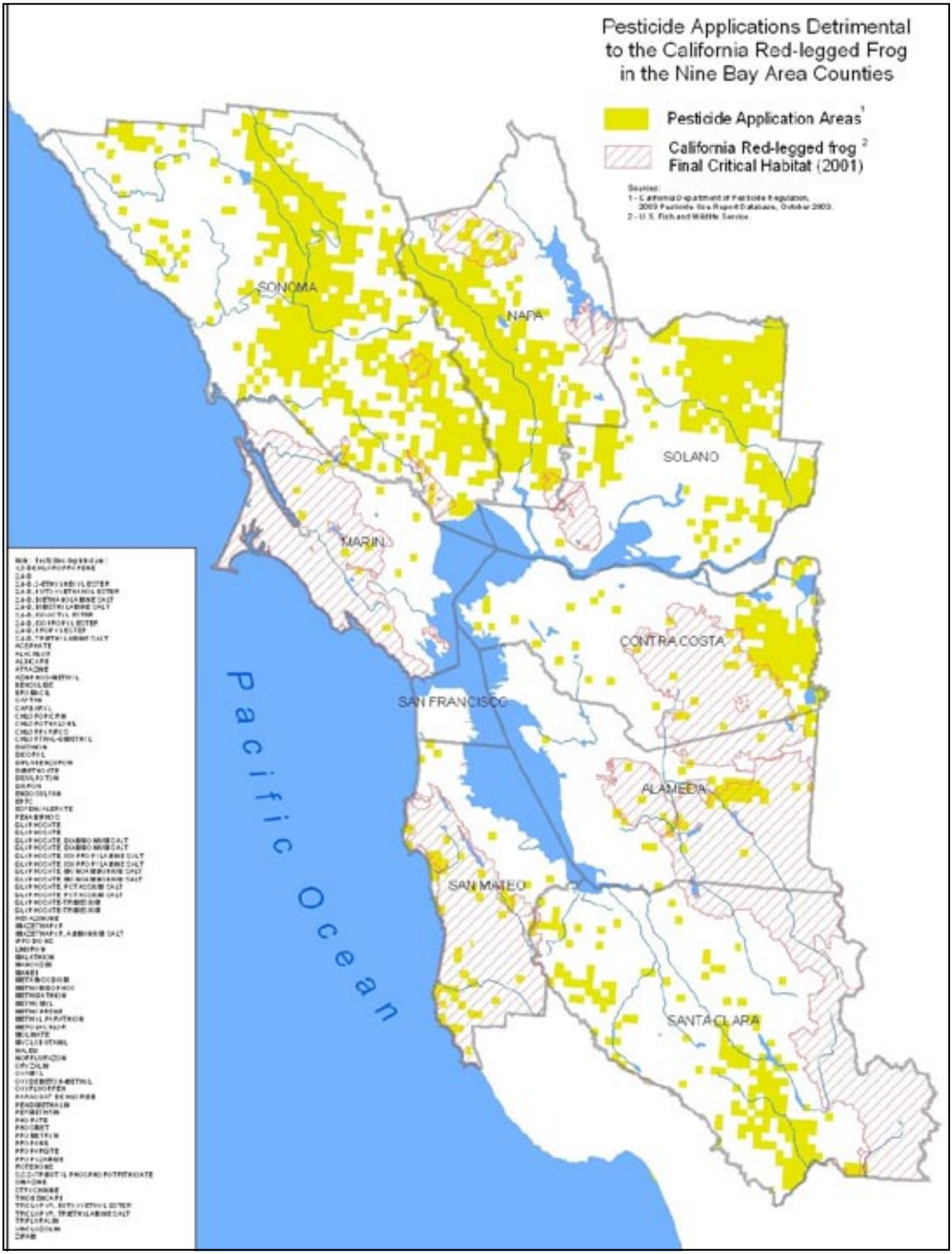
- Buy organic foods whenever possible. Market forces are a powerful incentive to encourage growers to go organic.

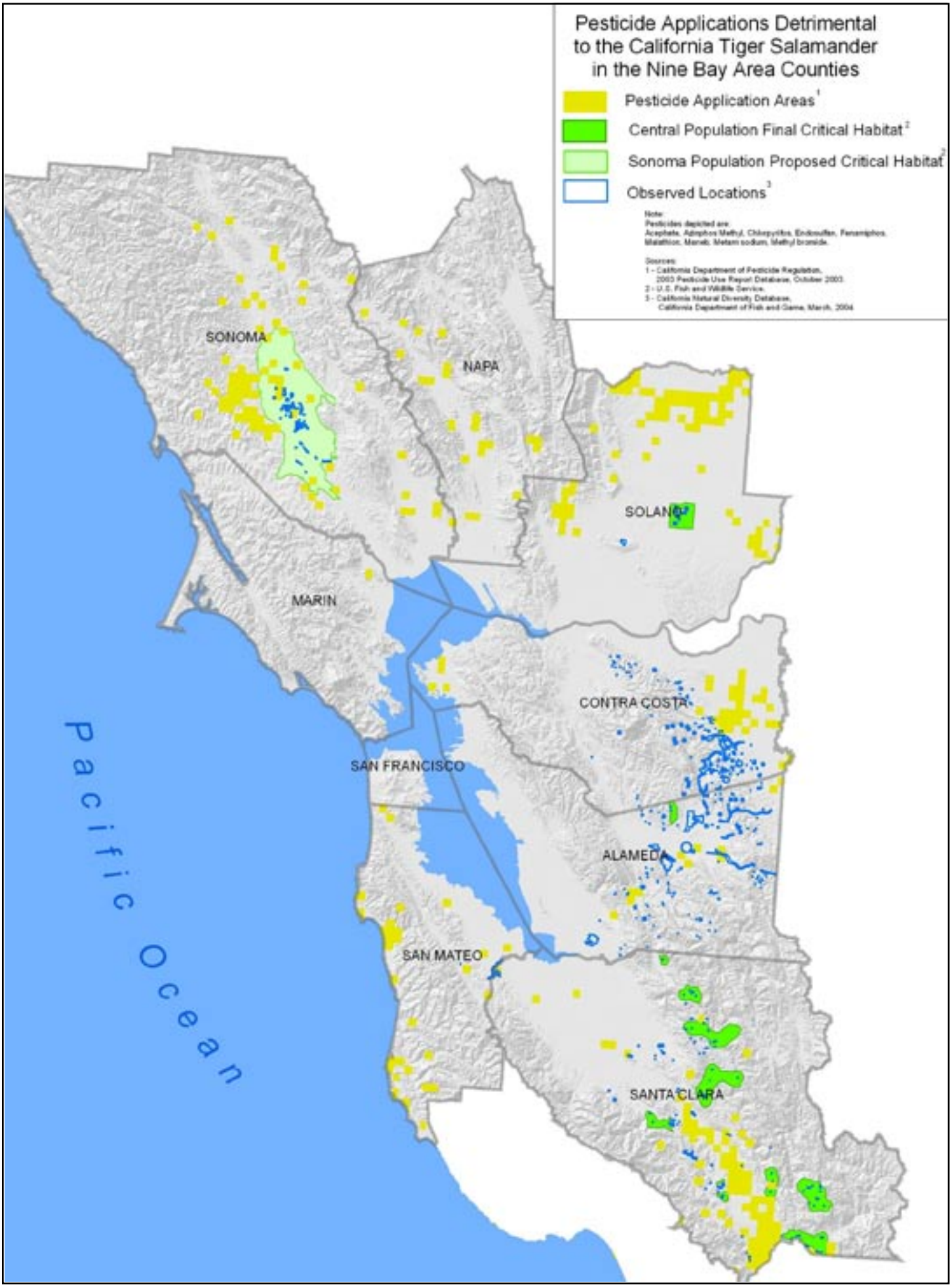
- Insist on least-toxic pest management in your children's schools and support efforts to phase out use of toxic pesticides in schools. Many schools now have a "no toxic pesticides" policy. If yours does not, work with other parents and teachers to implement such a policy at your school.

Maps of Bay Area Pesticide Use in Endangered Species Habitat


Major Tributaries
of the Nine Bay Area Counties
SONOMA
NAPA
SOLANO
MARIN
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
SAN MATEO
SANTA CLARA
Pacific Ocean


Pesticide Applications Detrimental to the San Joaquin Kit Fox in the Nine Bay Area Counties
Pesticide Application Areas 1
San Joaquin kit fox range 2
Note:
Pesticides depicted are:
aluminum phosphide, brodifacoum, bromadiolone, chlorophacinone, diphacinone, magnesium phosphide, sodium nitrate, and strychnine.
Sources:
1 - California Department of Pesticide Regulation, 2003 Pesticide Use Report Database, October 2003.
2 - California Natural Diversity Database, California Department of Fish and Game, March, 2004
SONOMA
NAPA
SOLANO
MARIN
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
SAN MATEO
SANTA CLARA
Pacific Ocean


Pesticide Applications Detrimental to the California Red-legged Frog in the Nine Bay Area Counties
Pesticide Application Areas[1]
California Red-legged frog[2] Final Critical Habitat (2001)
Sources:
1 - California Department of Pesticide Regulation, 2003 Pesticide Use Report Database, October 2003.
2 - U.S. Fish and Wildlife Service.
SONOMA
NAPA
SOLANO
MARIN
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
SAN MATEO
SANTA CLARA
Pacific Ocean


Pesticide Applications Detrimental to the California Tiger Salamander in the Nine Bay Area Counties
Pesticide Application Areas[1]
Central Population Final Critical Habitat[2]
Sonoma Population Proposed Critical Habitat[2]
Observed Locations[3]
Note:
Pesticides depicted are:
Acephate, Azinphos Methyl, Chlorpyrifos, Endosulfan, Fenamiphos, Malathion, Maneb, Metam sodium, Methyl bromide.
Sources:
1 - California Department of Pesticide Regulation, 2003 Pesticide Use Report Database, October 2003.
2 - U.S. Fish and Wildlife Service.
3 - California Natural Diversity Database, California Department of Fish and Game, March, 2004.
SONOMA
NAPA
SOLANO
MARIN
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
SAN MATEO
SANTA CLARA
Pacific Ocean

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[*] The following policy recommendations for the California and U.S. Environmental Protection Agencies and pesticide use recommendations for the general public are largely taken from the Pesticide Action Network North America 1999 report, *Disrupting the Balance: Ecological Impacts of Pesticides in California*.

Center for Biological Diversity Pesticides Reform Campaign

The Center's Pesticides Reform Campaign is intended to hold the EPA accountable for pesticides it registers for public use, and to cancel or restrict use of harmful pesticides within endangered species habitats. The Pesticides Reform Campaign provides analysis of pesticide impacts on endangered species and education about the threats toxic pesticides pose to wildlife and human health. A key component of this campaign is the Center's 2004 report detailing the failure of the EPA to regulate pesticides harmful to endangered species and this report on pesticide impacts to Bay Area endangered species. The Center is also filing a series of strategic legal challenges against the EPA to compel it to adhere to federal environmental law when registering pesticides. The legal actions seek EPA compliance regarding pesticide impacts to specific imperiled species and also programmatic changes in the agency's registration process.

The Center and other conservation groups have been forced to file numerous lawsuits to attempt to compel the EPA to consult on pesticide impacts to endangered species. The Center filed litigation in 2002 challenging approval of 250 pesticides that may affect the California red-legged frog. A federal court found in September of 2005 that the EPA violated the Endangered Species Act by registering 66 of these pesticides for use without considering how they might impact the continued existence of the red-legged frog. In January of 2006 the Center filed a legal motion asking the court to prohibit use of the pesticides in and adjacent to core red-legged frog habitats until formal consultation is completed. The requested injunction would apply within and immediately adjacent to ponds, streams and wetlands within core recovery areas, encompassing 160 yard pesticide-free buffers for aerial applications to prevent pesticide drift and 80 yard buffers for ground applications to prevent runoff. The motion also asks for consumer hazard warnings where the pesticides are sold, so consumers can protect red-legged frogs.

More information about the Center's Pesticides Reform Campaign can be found at
http://www.biologicaldiversity.org/swcbd/programs/science/pesticides/index.html